

Acoustical monitoring of bird migration – capabilities, limitations, and utility in the context of assessing use and impacts of wind turbines

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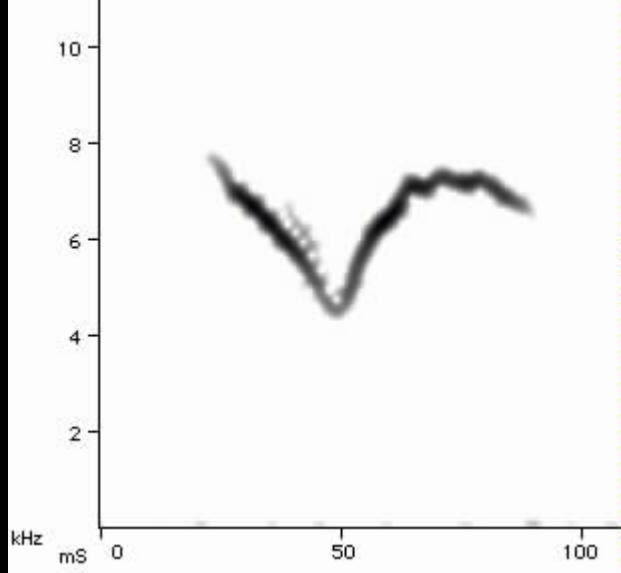




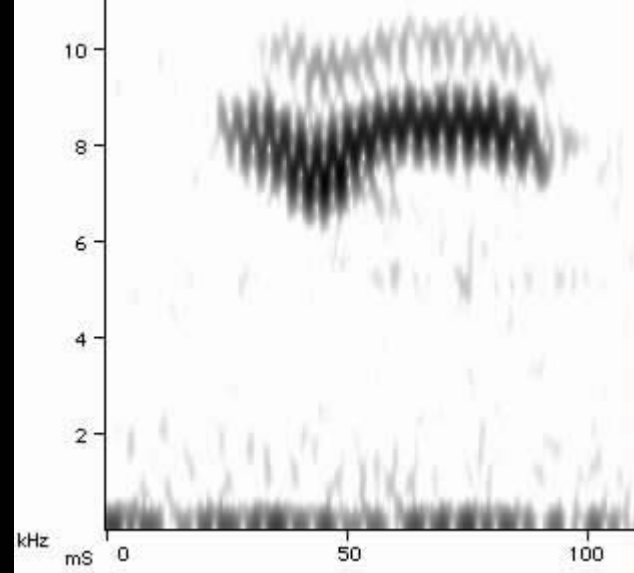
Early gear for recording sound in the night sky. The target in this case was avian night flight calls in the pioneering study by Richard Graber and William Cochran of the Illinois Natural History Survey



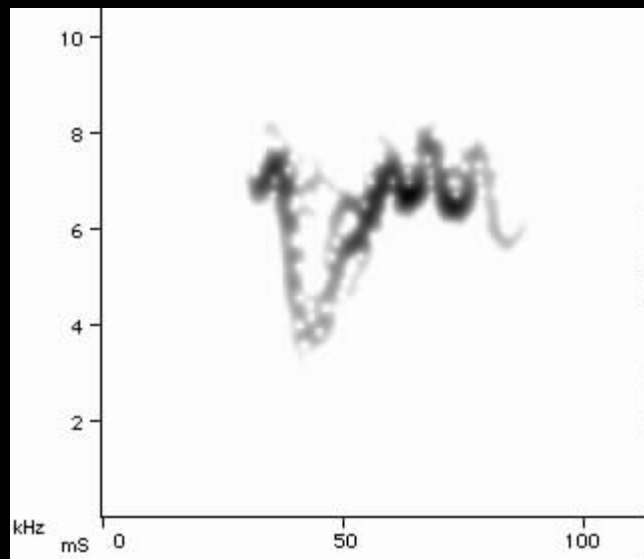
Development of modern technology advanced capabilities of acoustic study in the later 20th c. Microphones, audio recorders (VCR-Computer), software for spectrum analysis and automatic call detection. Picture shows mobile night flight call recording gear in 1988.



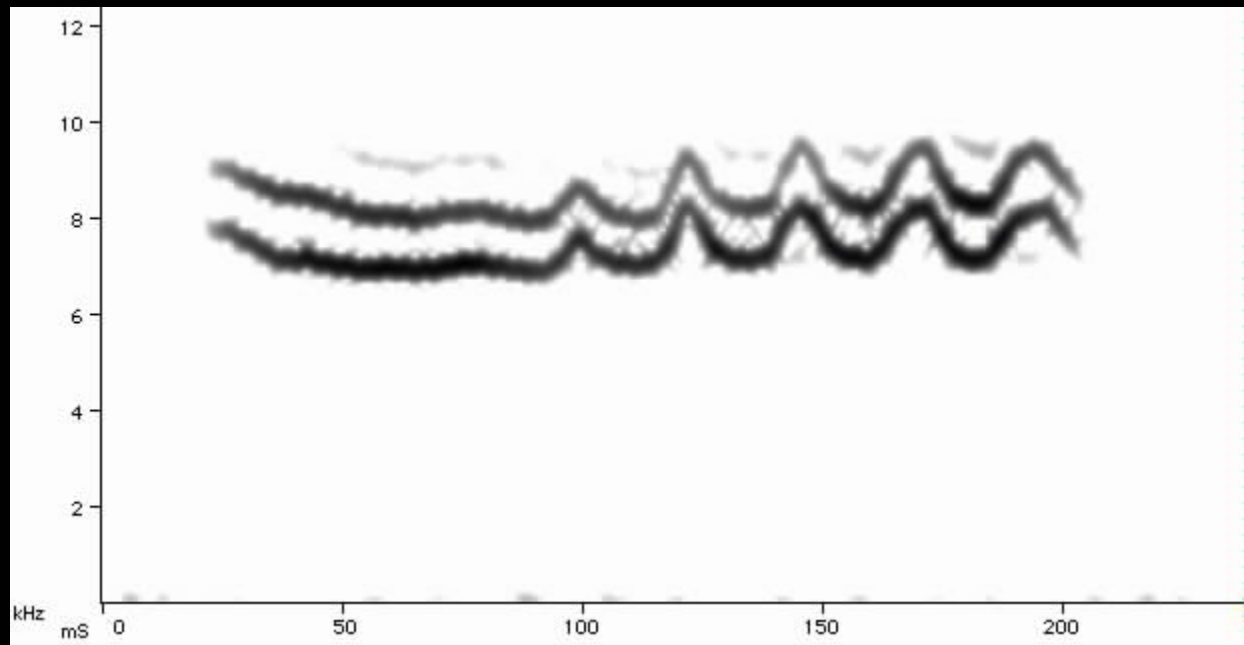
American Redstart



Black-and-white Warbler



Canada Warbler



White-throated Sparrow

FLIGHT CALLS OF MIGRATORY BIRDS

Eastern North American Landbirds

Flight Calls of Migratory Birds

Eastern North American Landbirds



William R. Evans and Michael O'Brien



Introduction

Microphone Design

Recording gear

Analysis Software

Flight Call Library

Publications

Products

Old Bird is a 501(c)(3) nonprofit corporation dedicated to facilitating acoustic monitoring of avian night flight calls. This organization has two primary branches of activity. One is the development and distribution of information and tools for advancing the method and utility of monitoring night flight calls of migrating birds. The second is the establishment and maintenance of networks of acoustic monitoring stations for gathering and distributing night flight call data for environmental education and understanding.

Dickcissel Migration Challenge Grant

A challenge grant for high school students in South Texas. Teams of students compete in determining the spring 2004 Dickcissel call totals detected at high schools across the Rio Grande Valley.

Dickcissel Migration Monitoring

Automated acoustic recording stations located at high schools across the Rio Grande Valley of south Texas record the number of Dickcissel call notes over the schools at night. This pilot project was initiated in spring 2000 with support from the United States Fish & Wildlife Service. It is the first to automatically monitor the passage of a species of bird in night migration by their flight calls. Follow the links to learn more.

Flight Calls of Migratory Birds [CD-Rom]

by William R. Evans and Michael O'Brien

A CD-Rom reference guide to the flight calls of 211 landbirds in eastern North America. Follow the link for information about ordering.

Questions or comments - Contact admin@oldbird.org

updated: January 11, 2005

www.oldbird.org

Source for information and tools for acoustic monitoring



Two varieties of weather-proof microphones mounted on roof of a residence. Desktop PC inside residence records data: < \$700/station.



Remote acoustic monitoring station using 110W solar panel deep cycle batteries, and laptop computer: < \$1500/station.

Applications of acoustic bird monitoring for the wind power industry

by

William R. Evans

Cornell Laboratory of Ornithology, Ithaca, NY

National Avian-Wind Power Planning Workshop III
San Diego, CA - April 1998

<http://www.nationalwind.org/publications/wildlife/avian98/21-Evans-Acoustics.pdf>

In 1998, only two acoustic studies had been carried out at wind turbines

(1994) New York State (Niagara Mohawk Power)

8-channel array

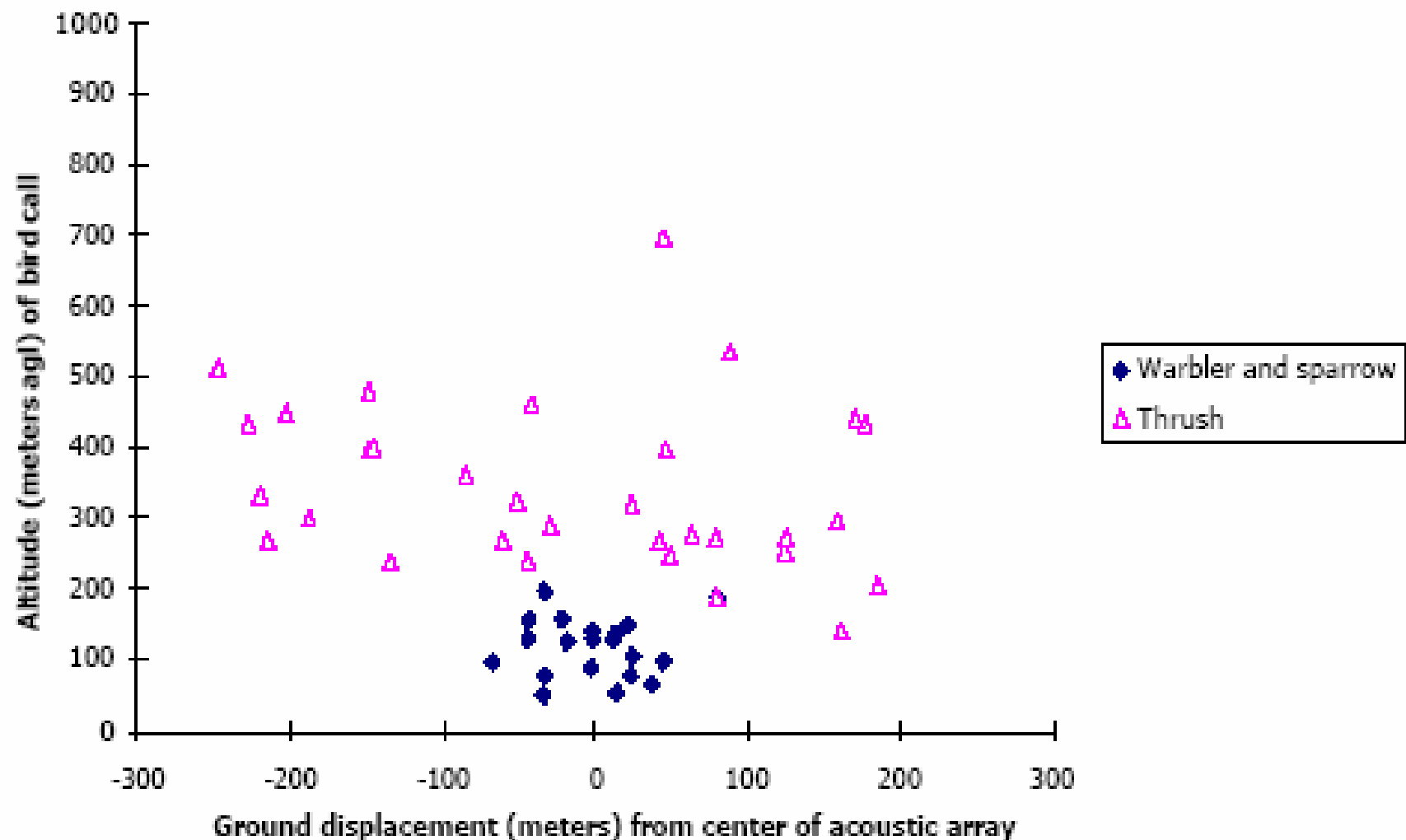
Comparison with marine radar (ABR, Inc.)

(1996) Nebraska (Nebraska Public Power District)

Species (Baird's Sparrow)

Broad front gradients of calling

Record collisions with structures or alarm calls



Approx. positions of calling birds determined from a ground-based 8-channel microphone array

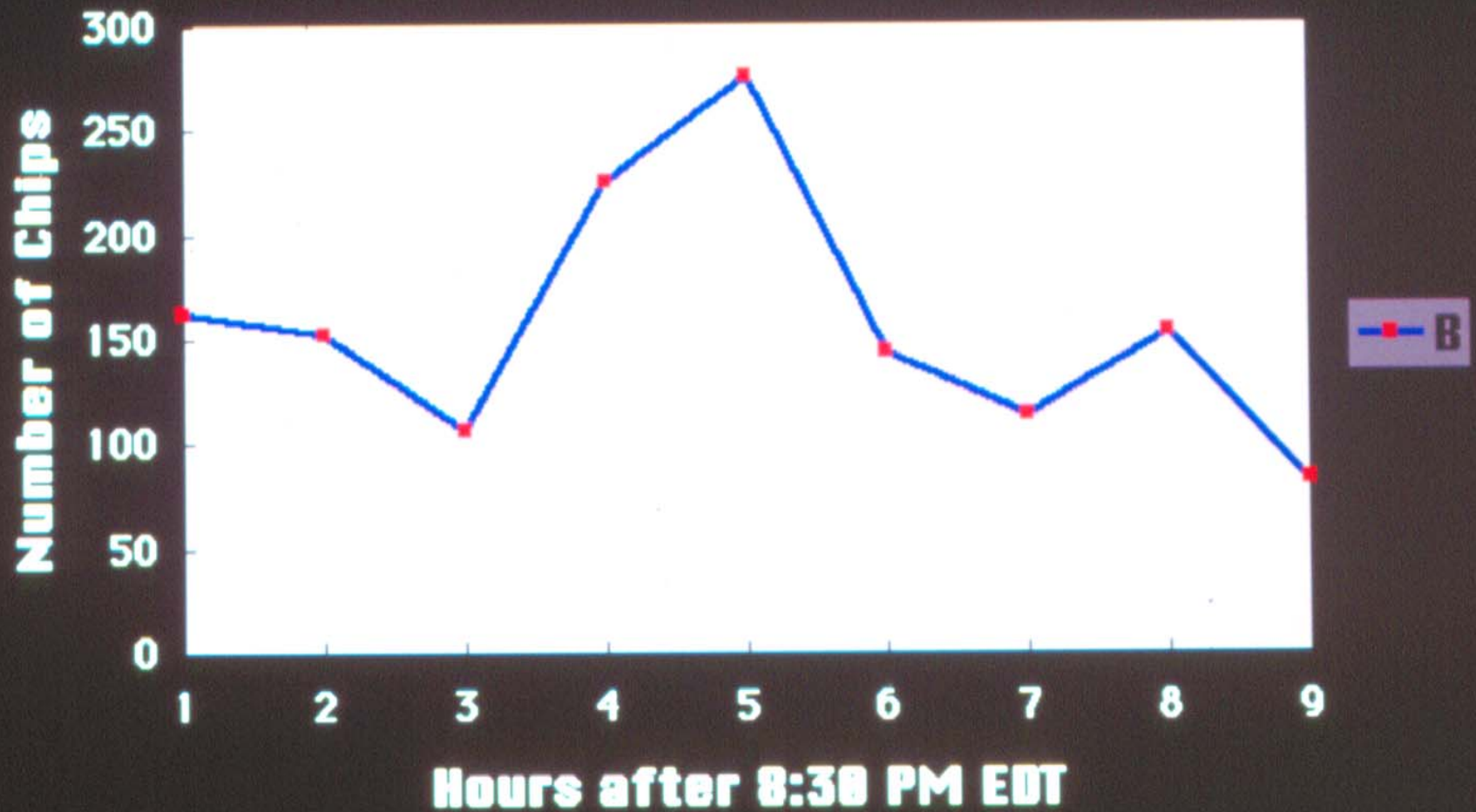


Site of Nebraska acoustic study at proposed wind project
Fall 1996 – Spring 1997. Study targeted species composition of
migrants and documented collisions with tower and distress calls.

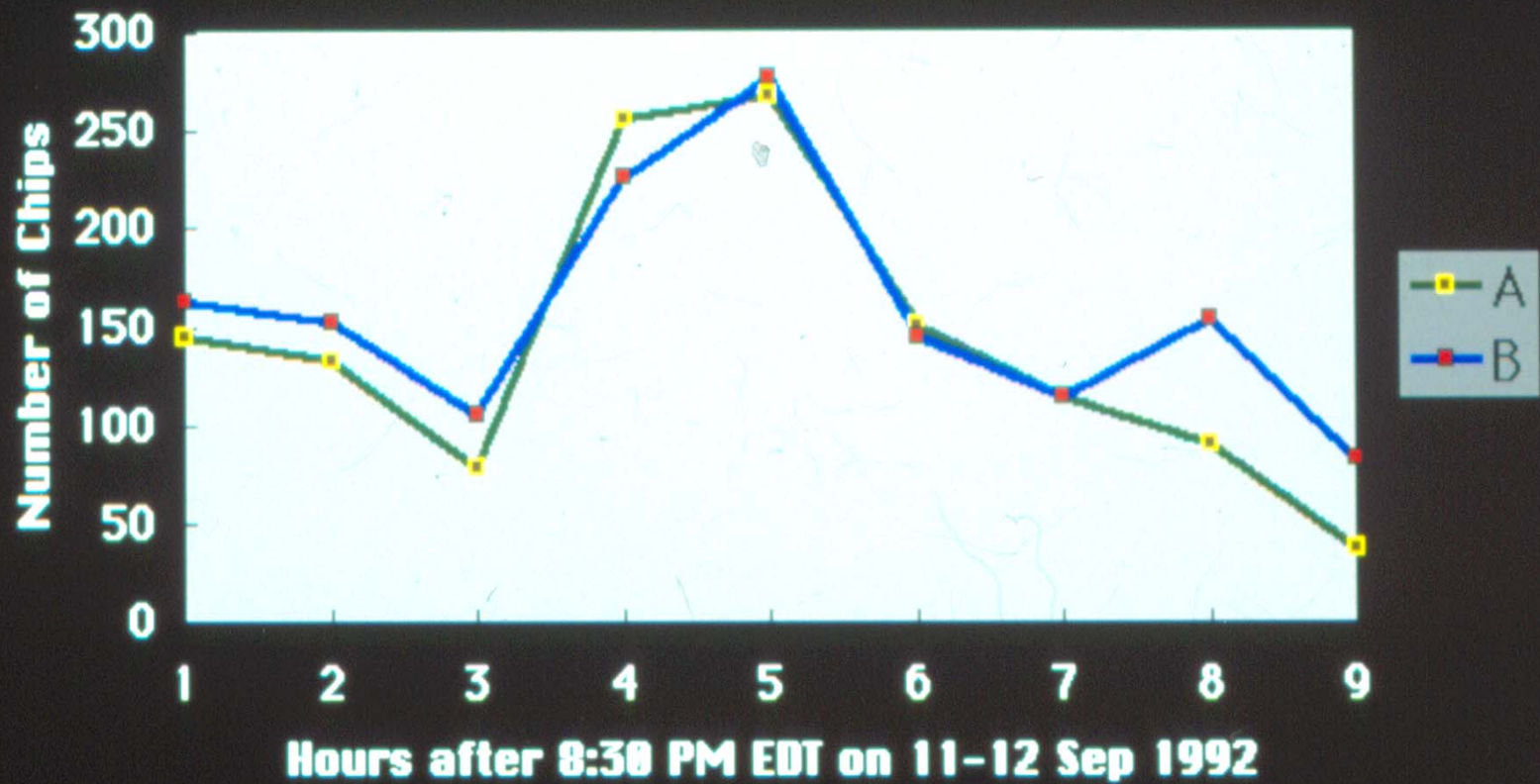
New York State Nocturnal Flight Call Monitoring Stations 1991-1994



Chips per hour at station B



Chips per hour at stations A and B



New York State Nocturnal Flight Call Monitoring Stations 1991-1994



Deerys: 1-2 Sep 1994



Use of acoustics in evaluating bird/wind since 1998

Cornell (1998-1999) New York (Niagara Mohawk Power Corp)

Evans/Old Bird (1999-2001) Wisconsin (Wisc. Public Power Corp)

Evans/Old Bird (2003-2004) Maryland/West Virginia (Clipper/US wind Force)

Evans/Old Bird (2004-2005) New York (Ecogen LLC)

Evans/Old Bird (2004-2005) Pennsylvania (Catamount Energy)

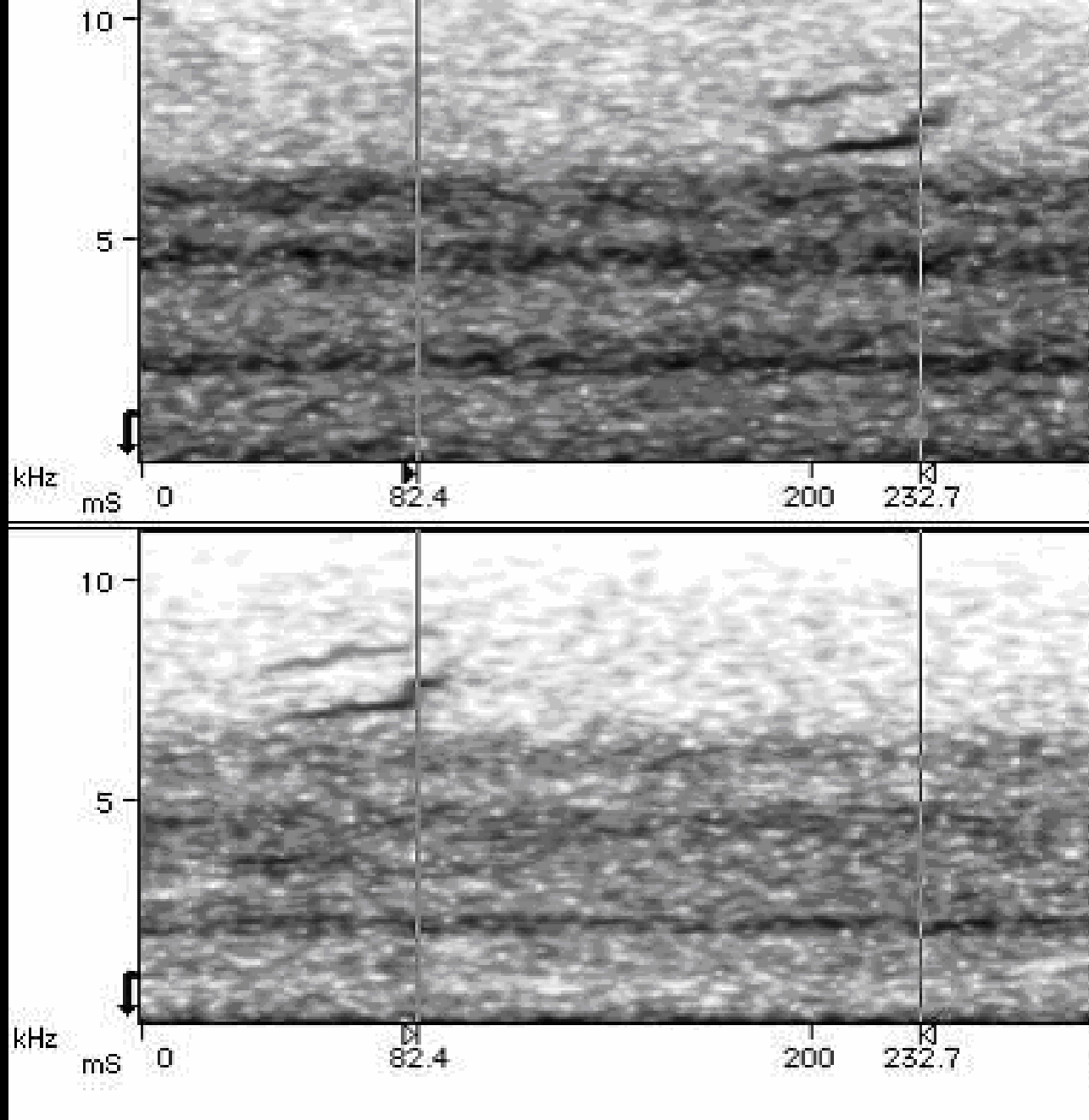
Evans/Old Bird (2004-2005) Vermont (Catamount Energy)

Mizrahi/New Jersey Audubon (2004) Pennsylvania

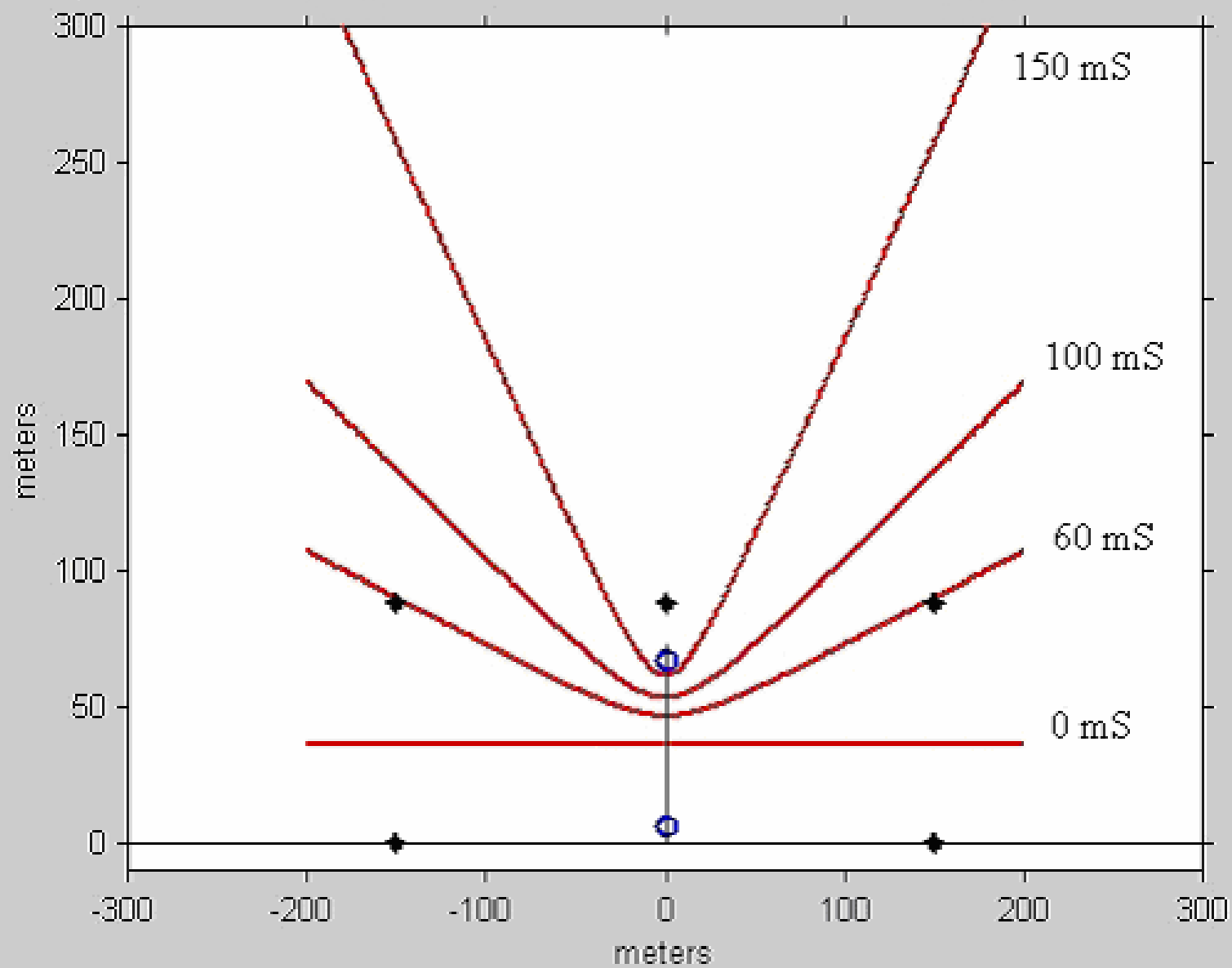
Deanna Dawson/USGS (2005) mid-Atlantic



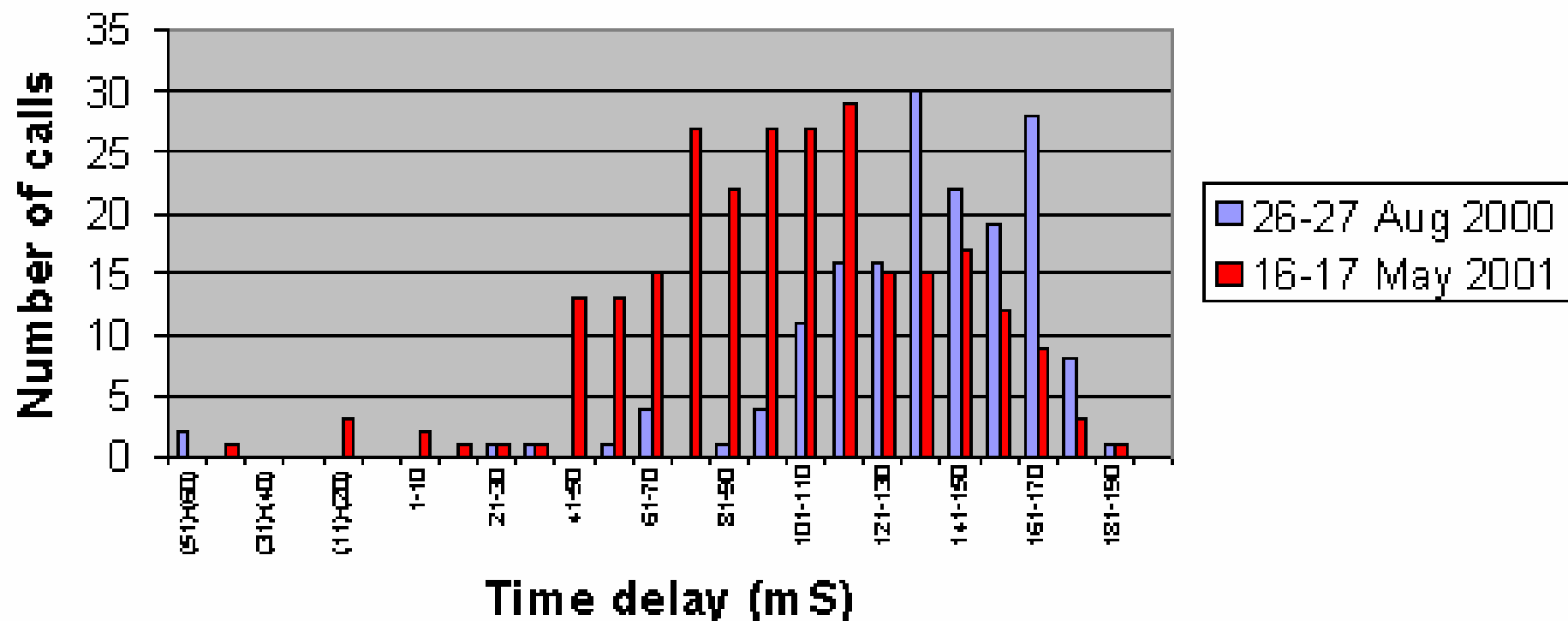
Met tower used for acoustic study at Wisconsin wind project. One mic was mounted at top and another at the base. Arrival time delays of calls were used to gain information on altitude of calling birds.

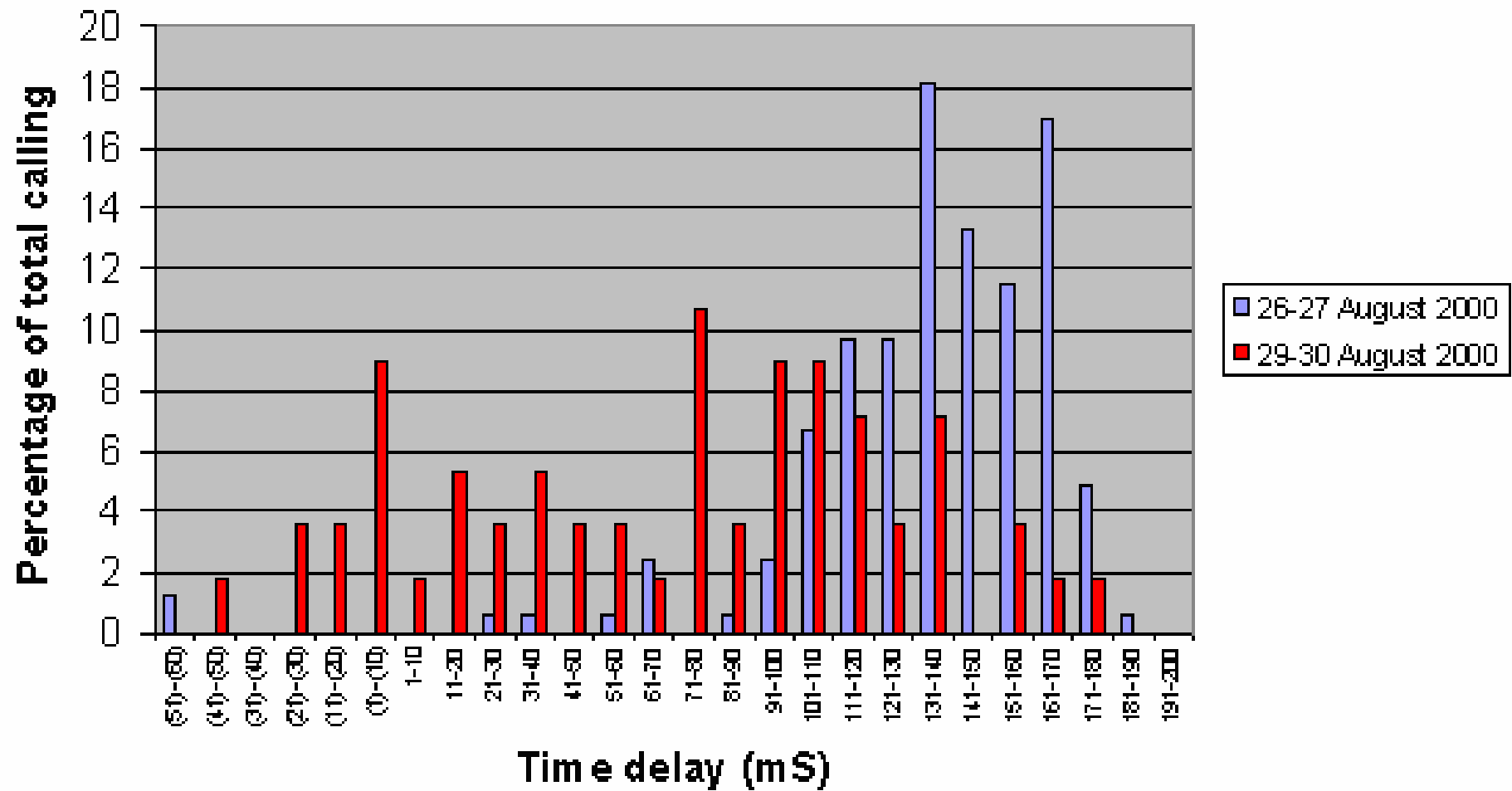


Example of arrival time delay



Time delays for biggest flight in fall 2000 and spring 2001





*Effects of Wind Turbines on Birds and Bats
in Northeastern Wisconsin*



a report submitted to Wisconsin Public Service Corporation
and Madison Gas and Electric Company

by

Robert W. Howe*, William Evans, and Amy T. Wolf*
*University of Wisconsin-Green Bay

21 November 2002

~20% of calling birds were determined by the 2-channel acoustic system to be below turbine height in spring and fall monitoring.

This is comparable figure to a number of radar altitude studies.

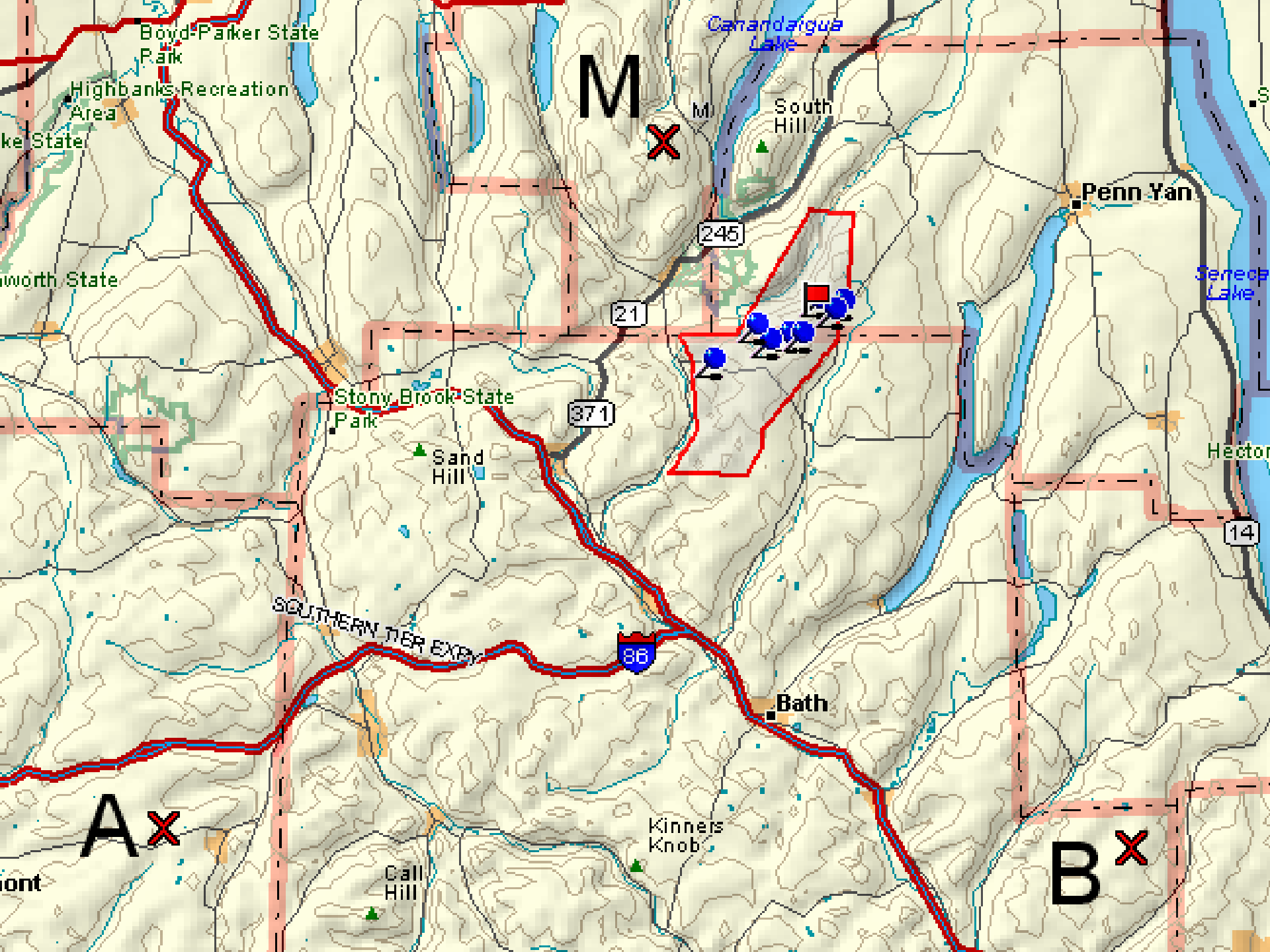
Yet only a few dead birds were found under 35 turbines.

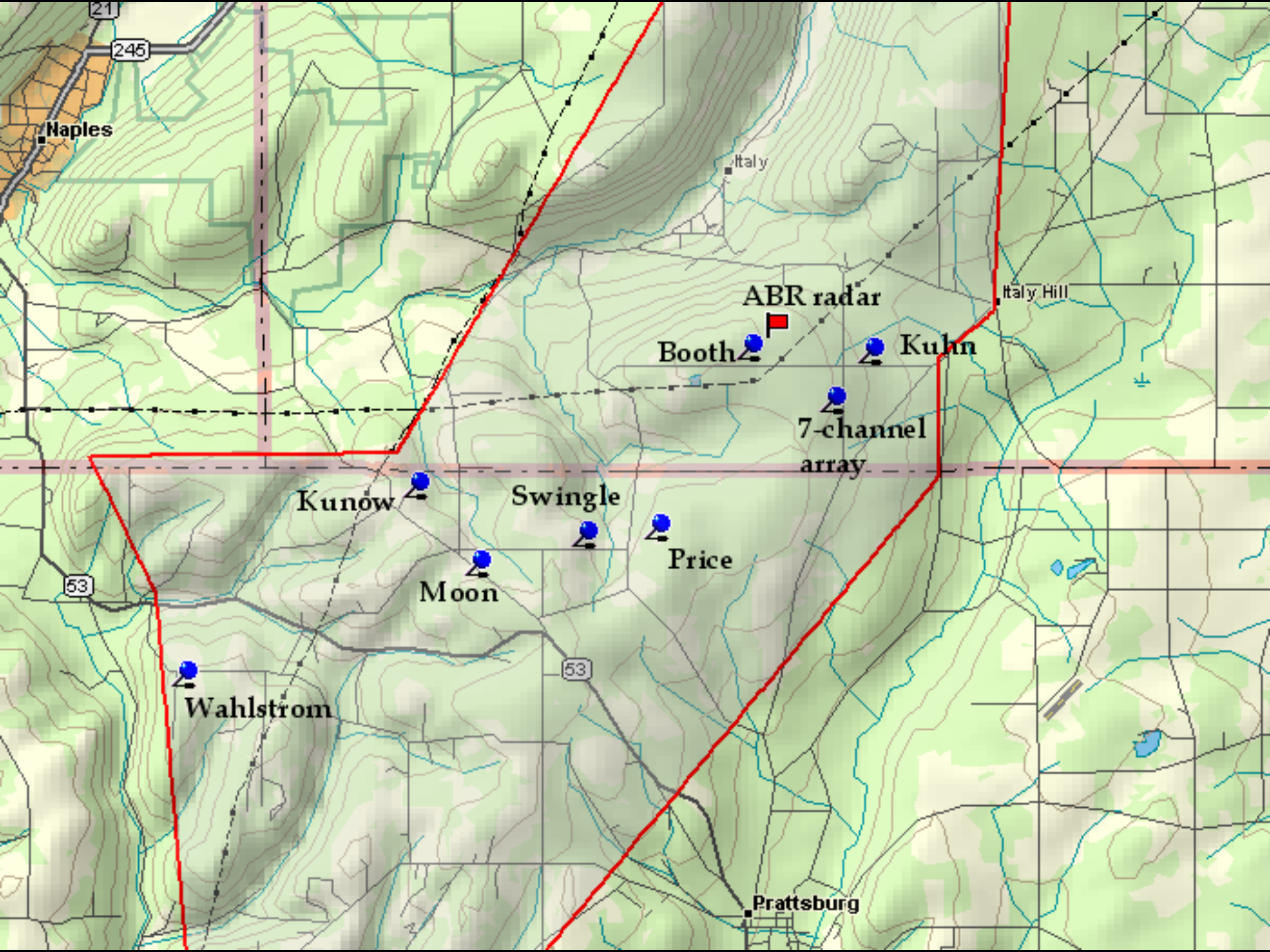


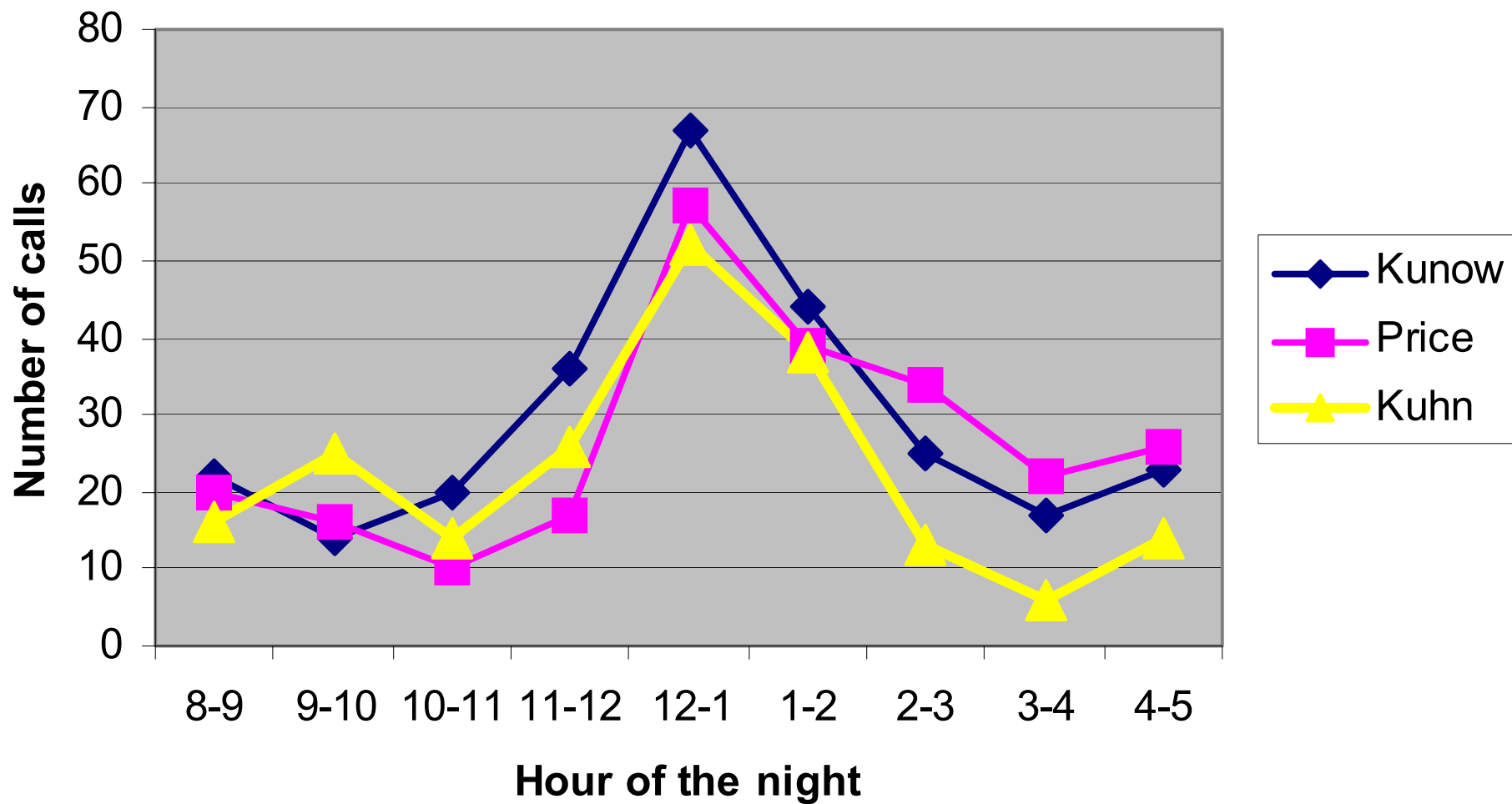
Site of Ecogen LLC commercial wind project

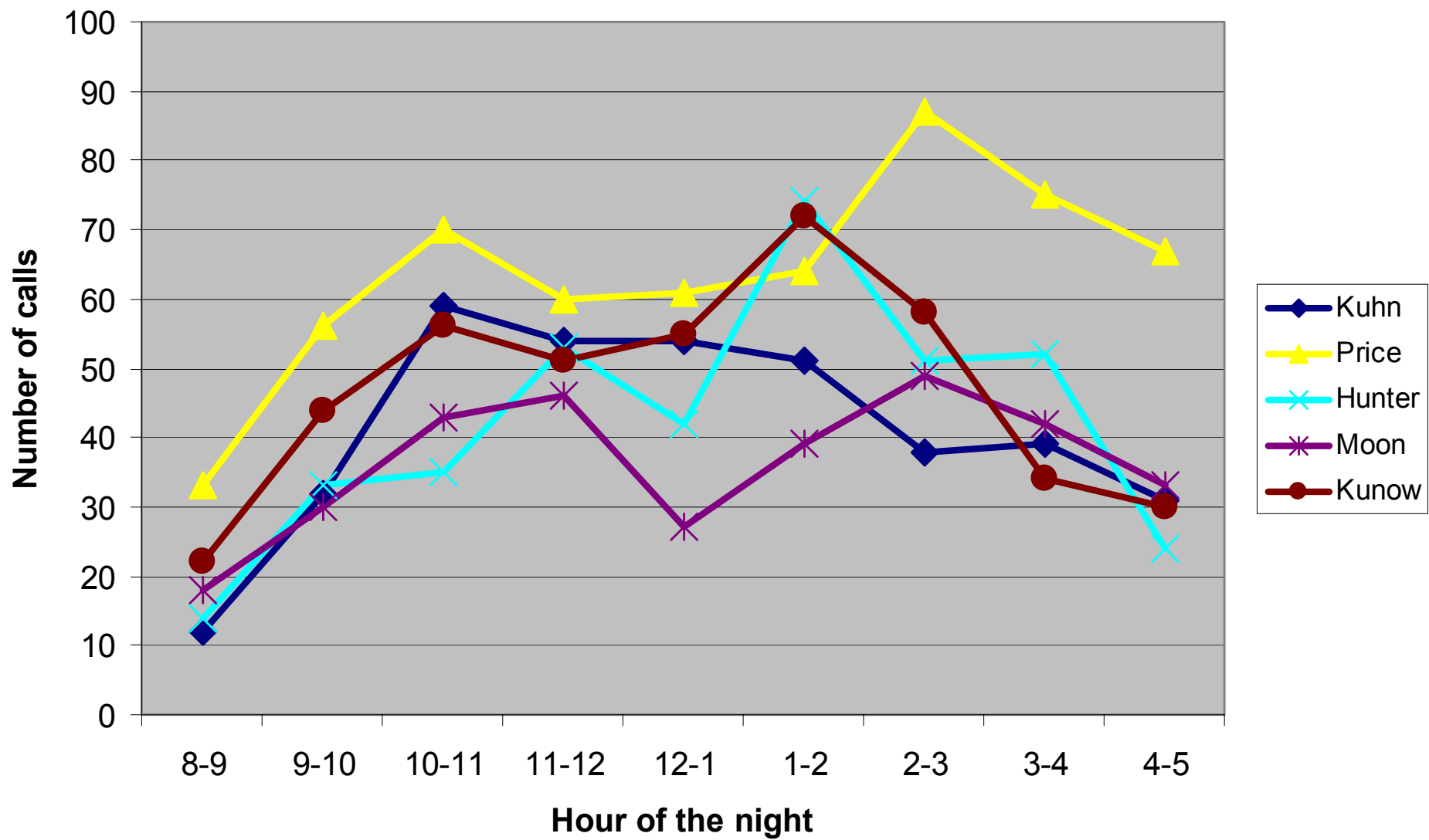
New York State Nocturnal Flight Call Monitoring Stations 1991-1994

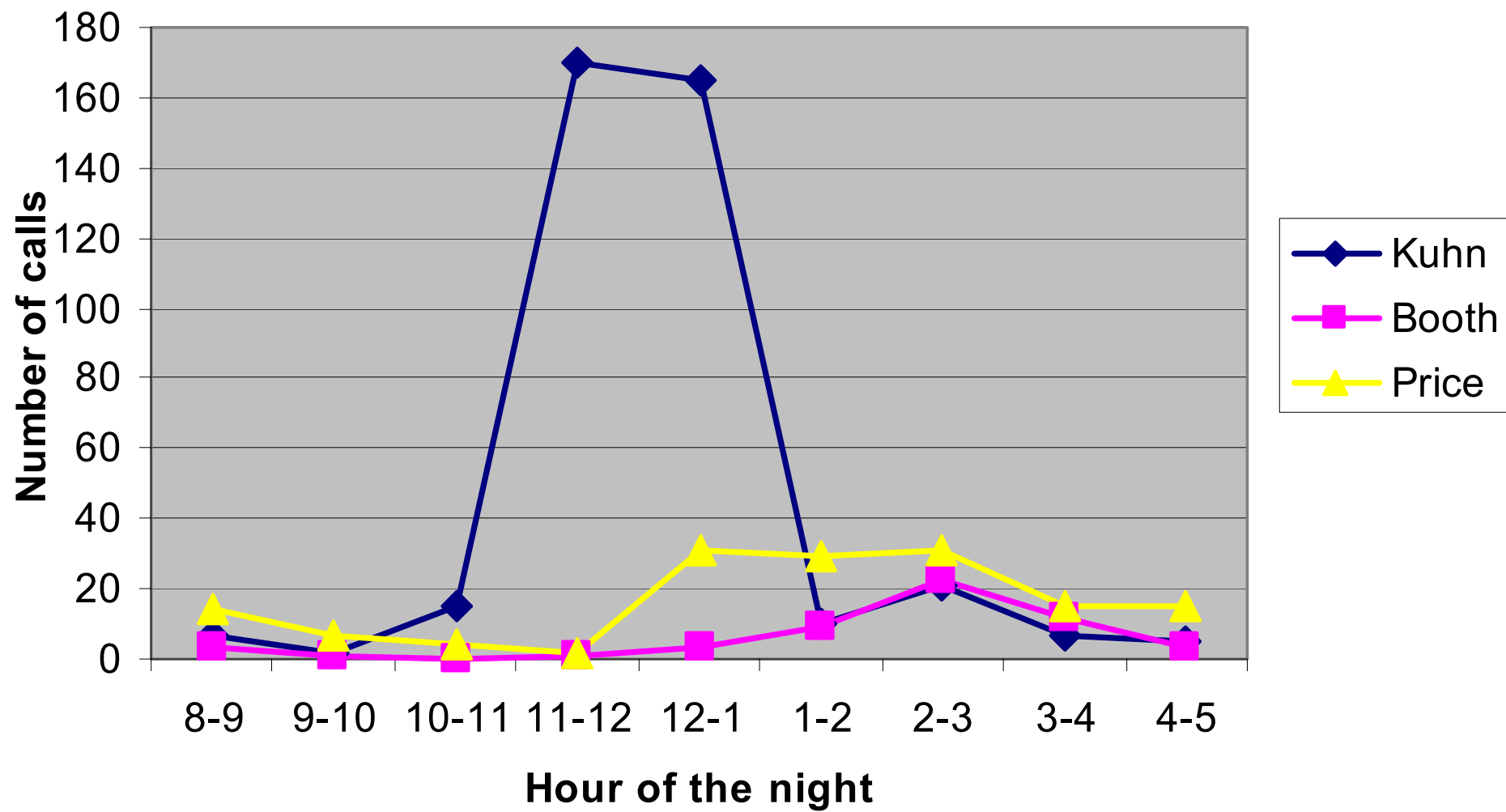


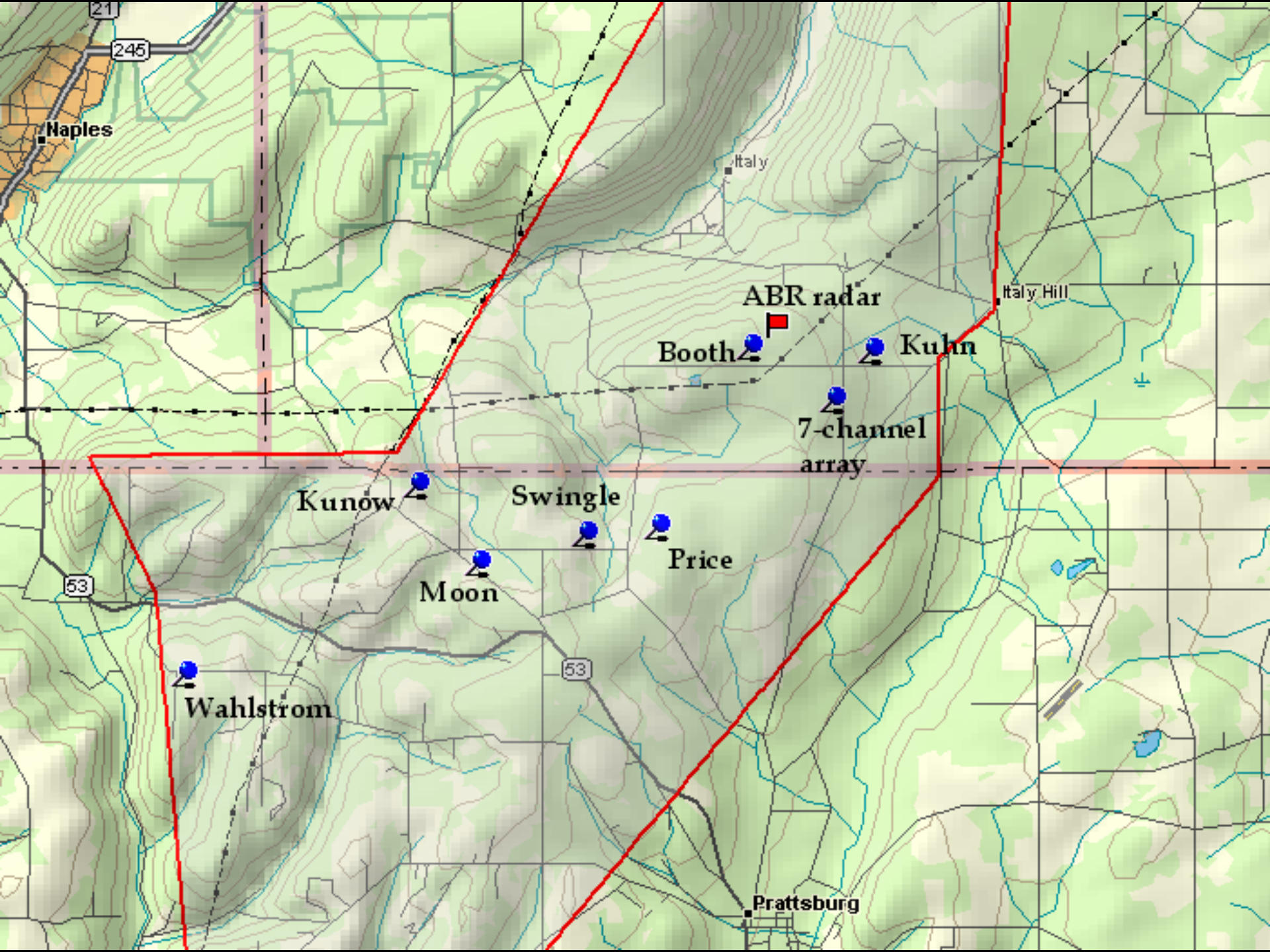


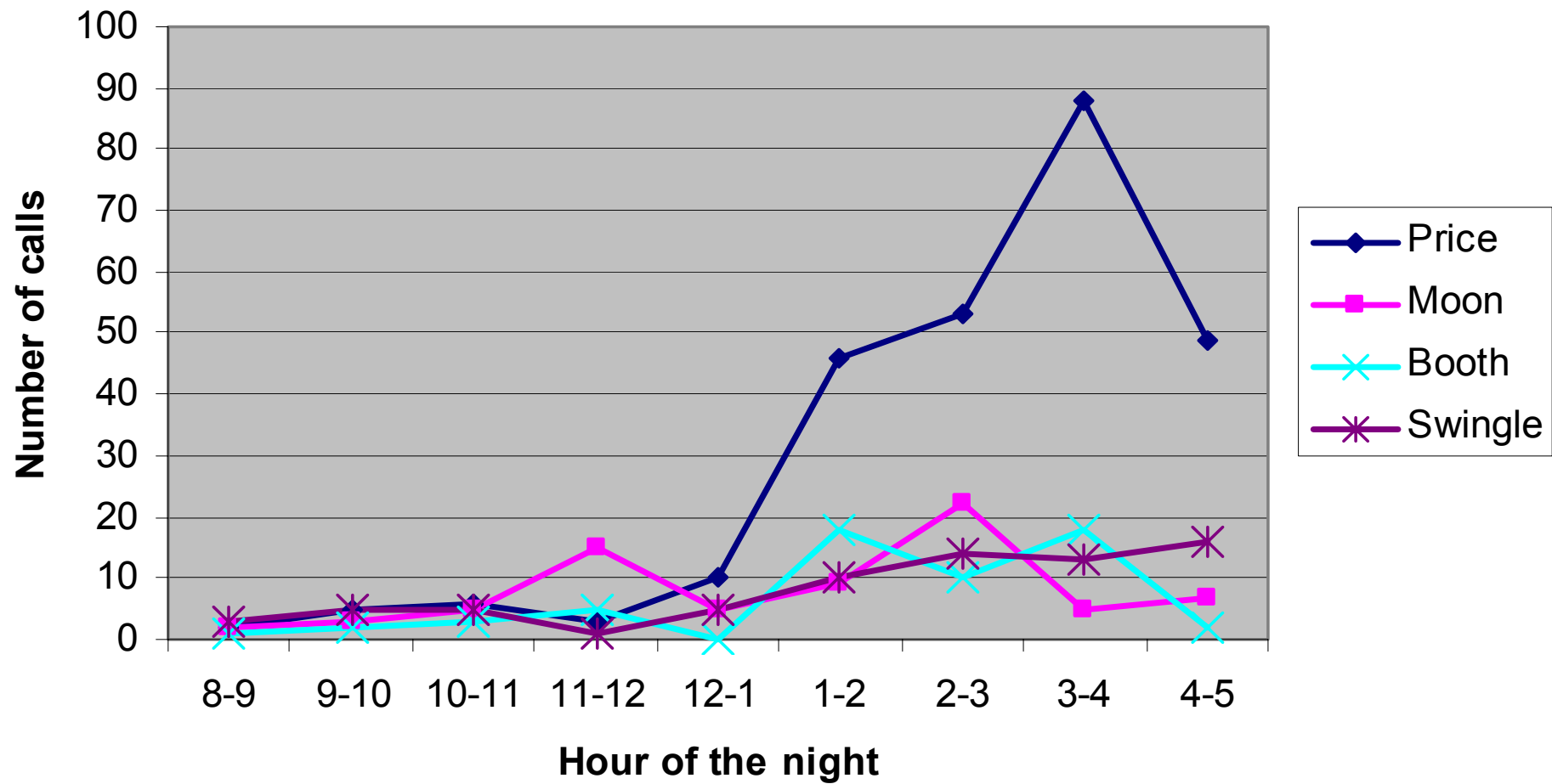


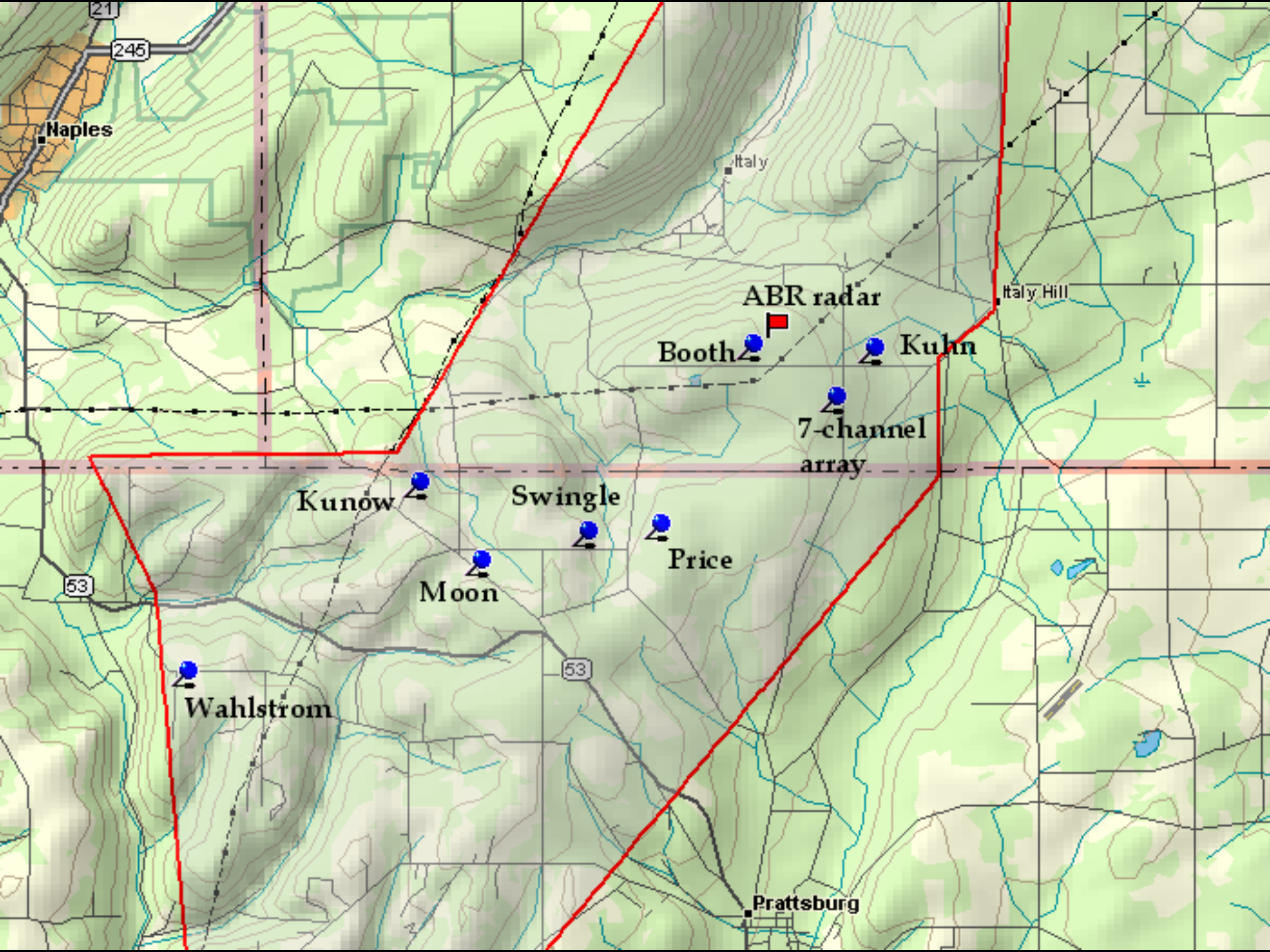


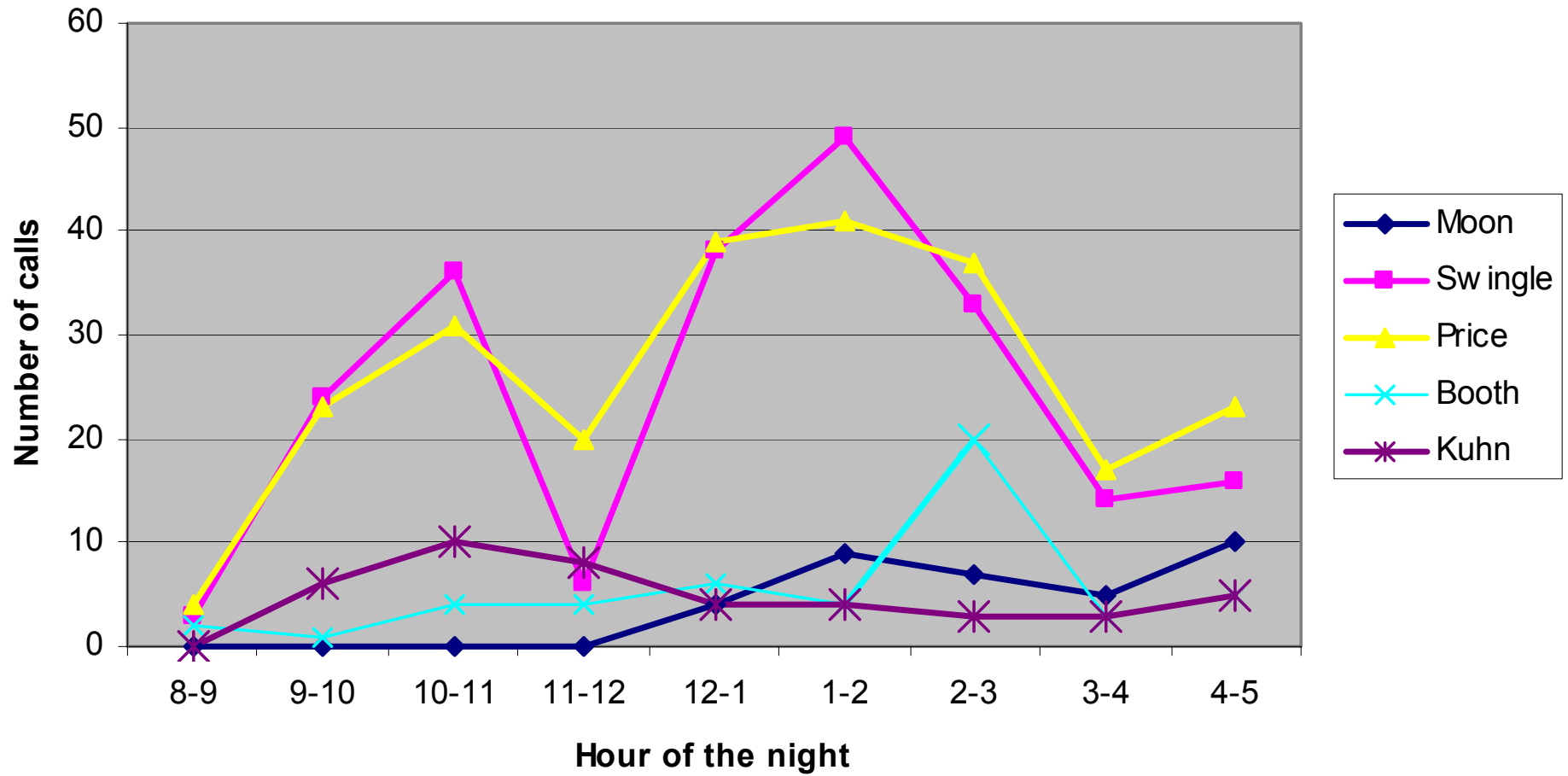


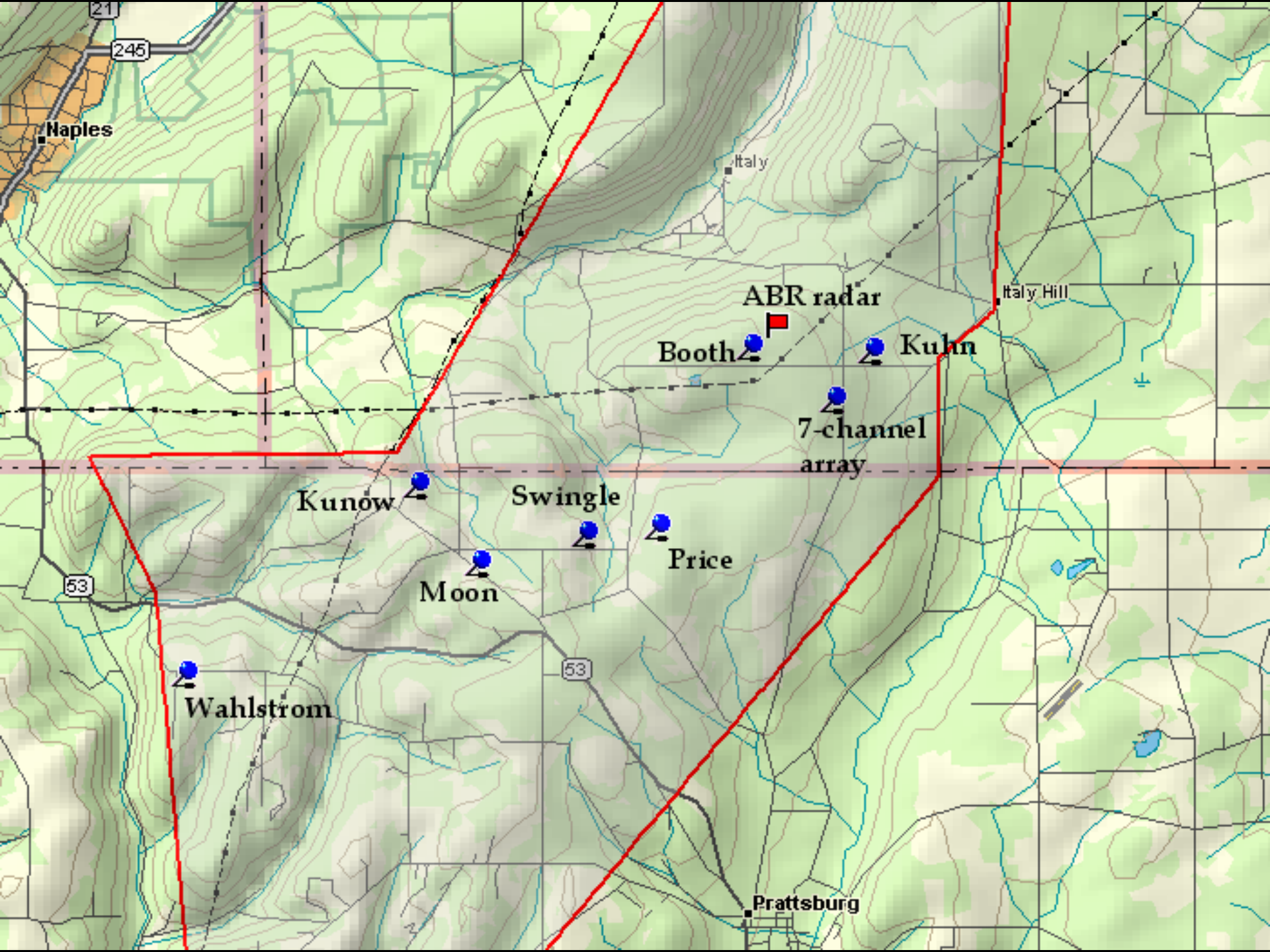


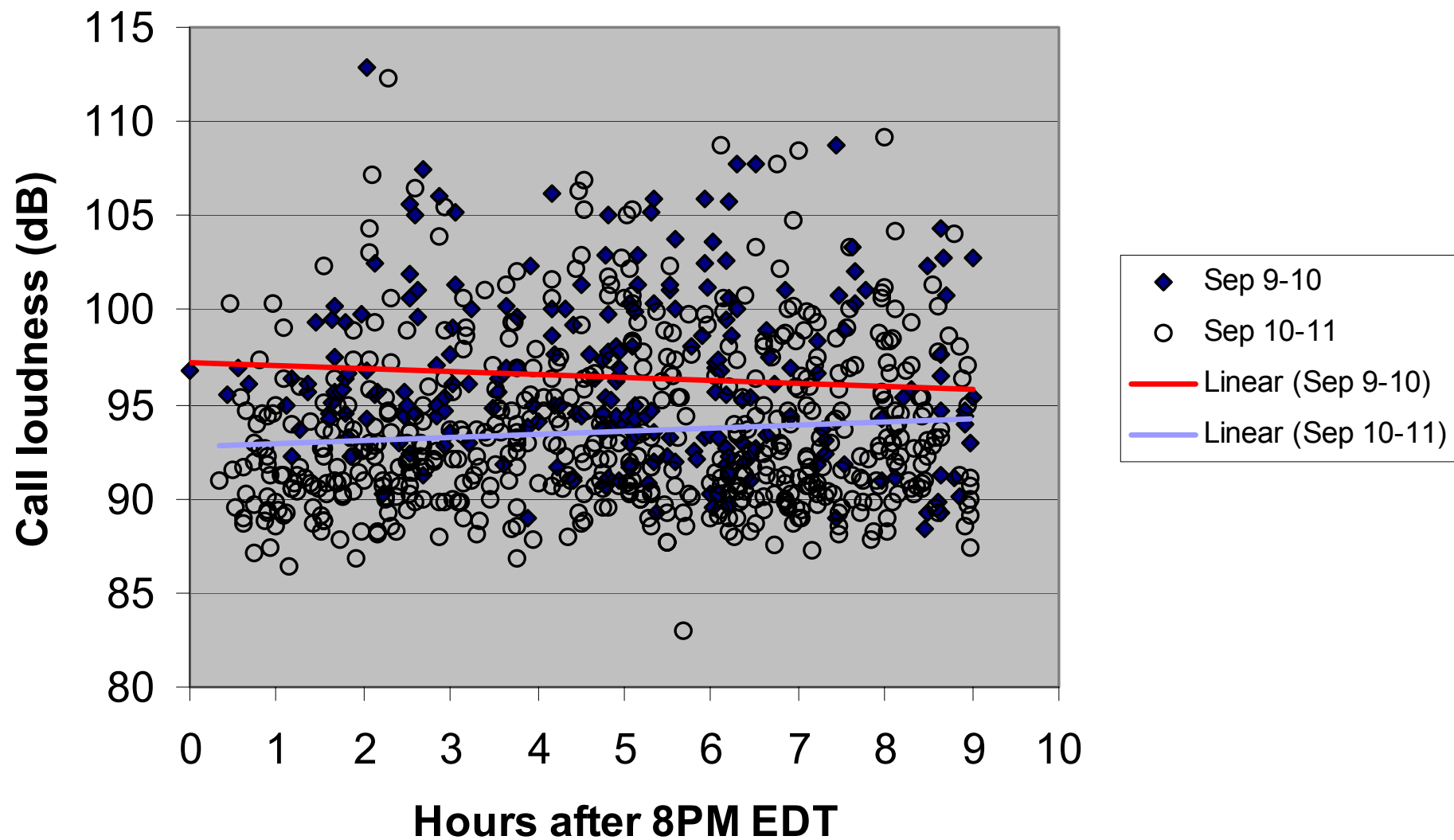


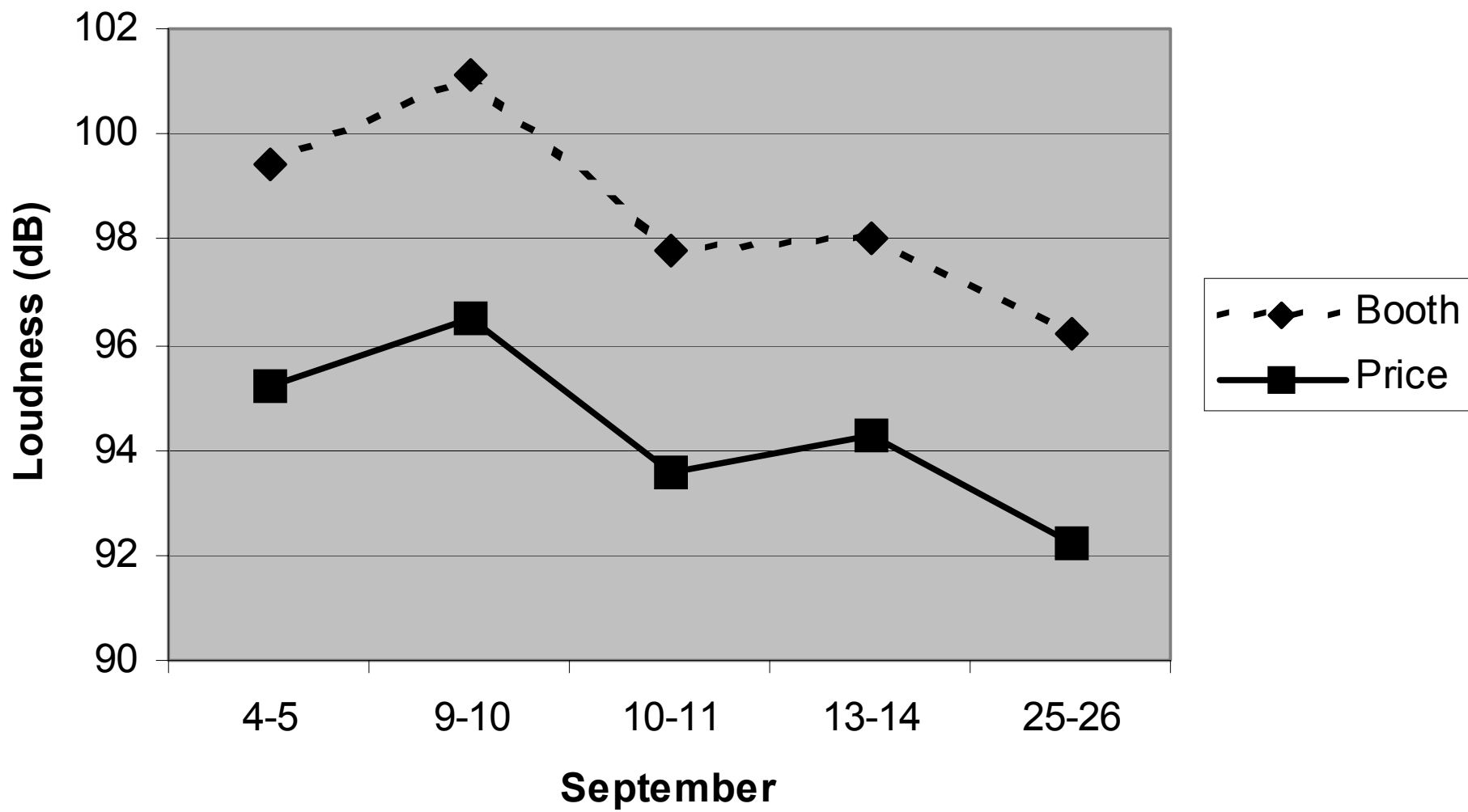












Correlation of acoustic with radar

We compared data for the nights of Aug 14-15 through Sep 29-30. The radar was down for 6 nights (4 of which had rain and few flight calls) and so we had 41 nights of comparison.

The surveillance radar sampled a 10-minute period every hour beginning at 15 minutes after the hour. Sampling began at 8:15PM and ended at 2:25AM each night. The acoustic monitoring occurred from 8:00PM to 5:00AM each night. To make the comparison with radar as close as possible, only the acoustic data from 8:00PM to 2:30AM was used.

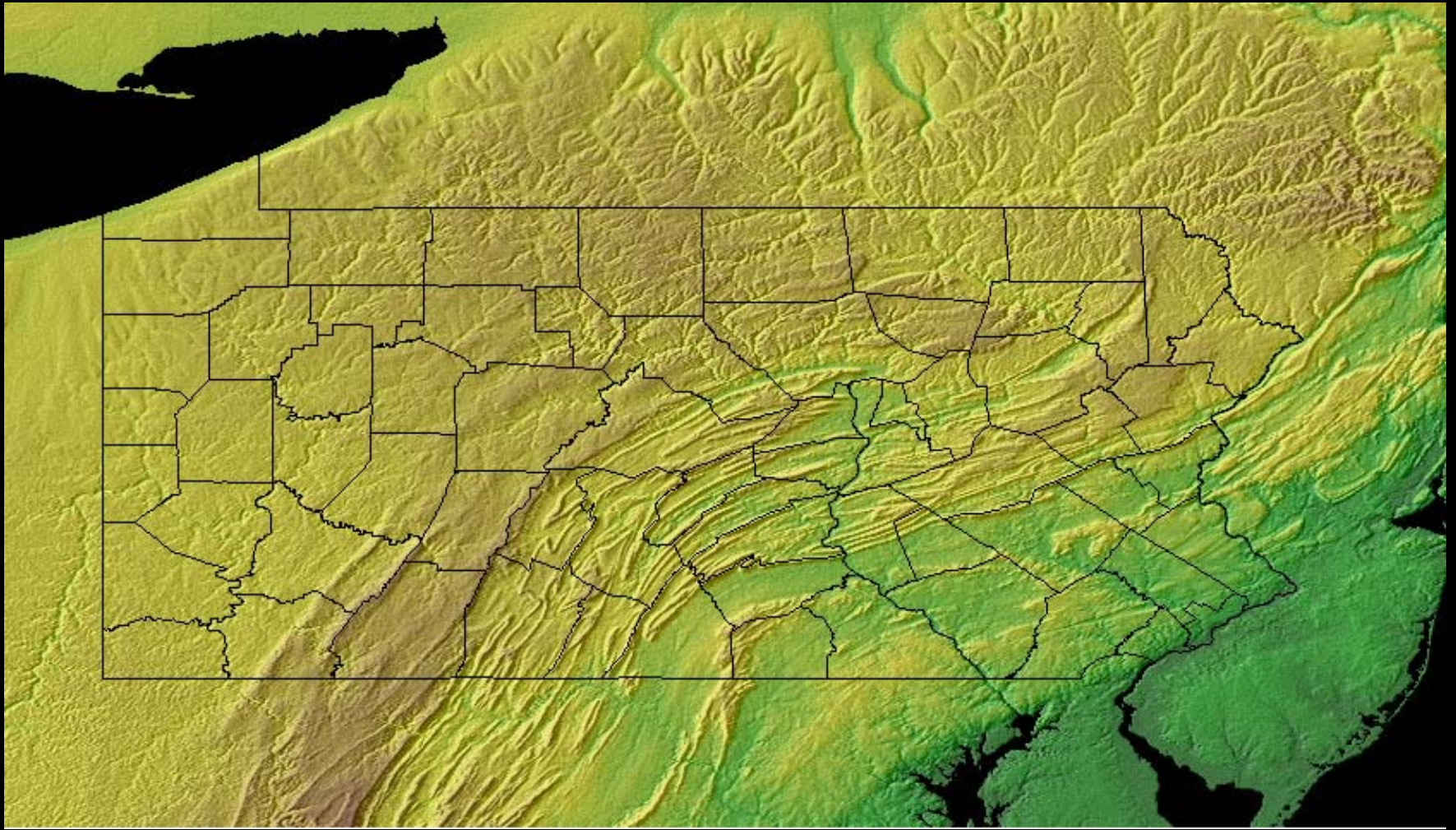
Good Spearman rank correlation coefficients of the total acoustic detection index and the radar passage rates within the three altitude ranges are listed below:

Total acoustic vs. <700-m radar = 0.73

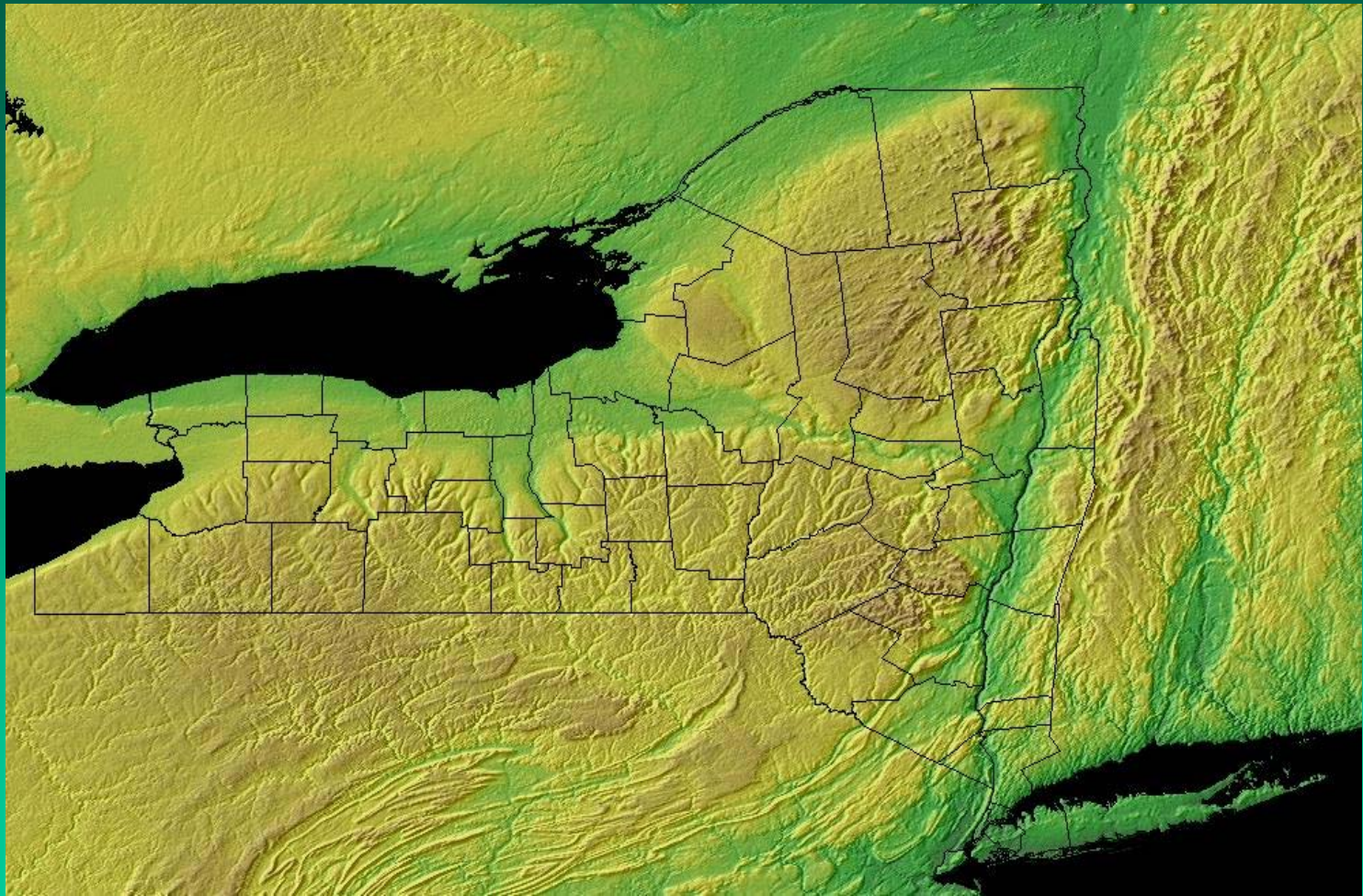
Total acoustic vs. <300-m radar = 0.67

Total acoustic vs. <125-m radar = 0.58

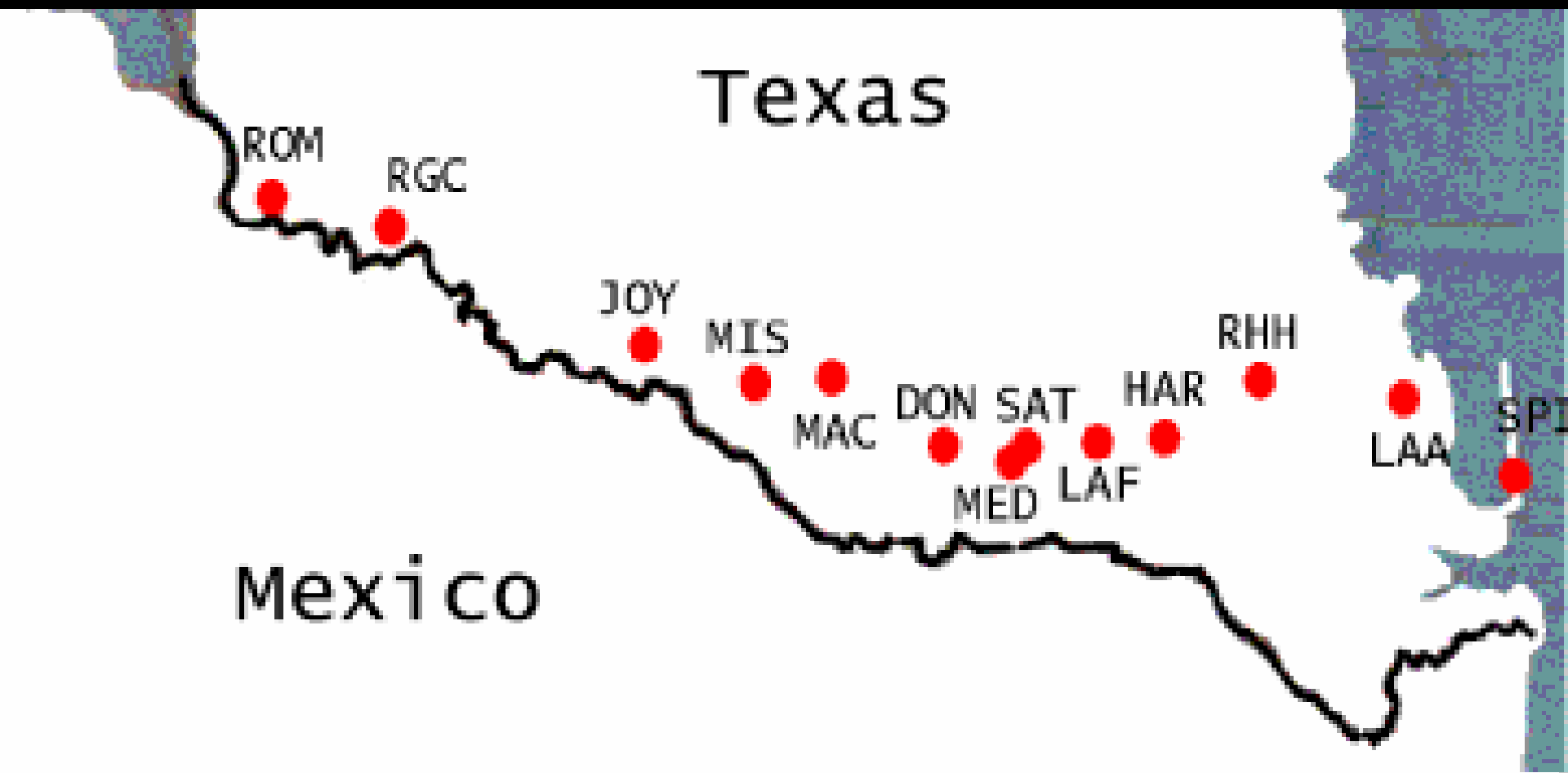
Note: range of acoustic system estimated to be ~750 m.



Vast area of montane terrain in the eastern Great Lakes Basin
That could cause channeling on low cloud ceiling migration



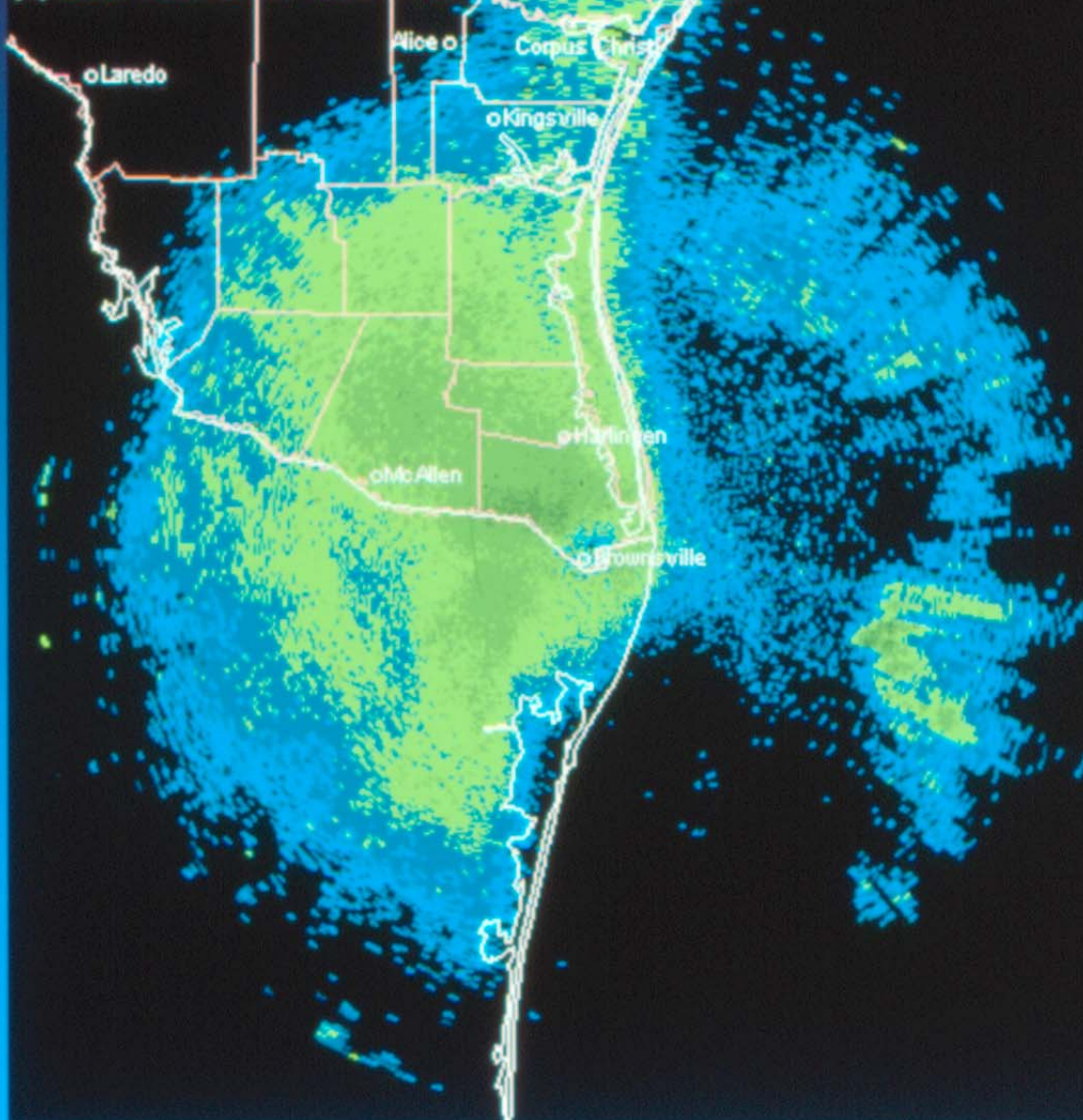
Vast area of montane terrain in the Great Lakes Basin
that could cause channeling on low cloud ceiling migration



High School-based acoustic monitoring transect in south Texas
2000-2005.

Brownsville NEXRAD 9:45PM CDT April 26, 2000

(c) 2000 weatherTAP.com 4/26/00 10:49:18 PM ET



BASE REFLECTIVITY

SITE: BRO

D/T: 04/27/00 0245Z

RANGE: 230 KM

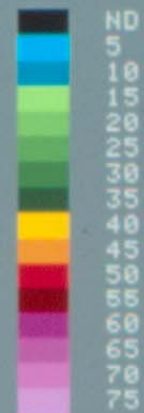
RES: 1 KM X 1 DEG

MODE: PRECIPITATION

UCP: 21

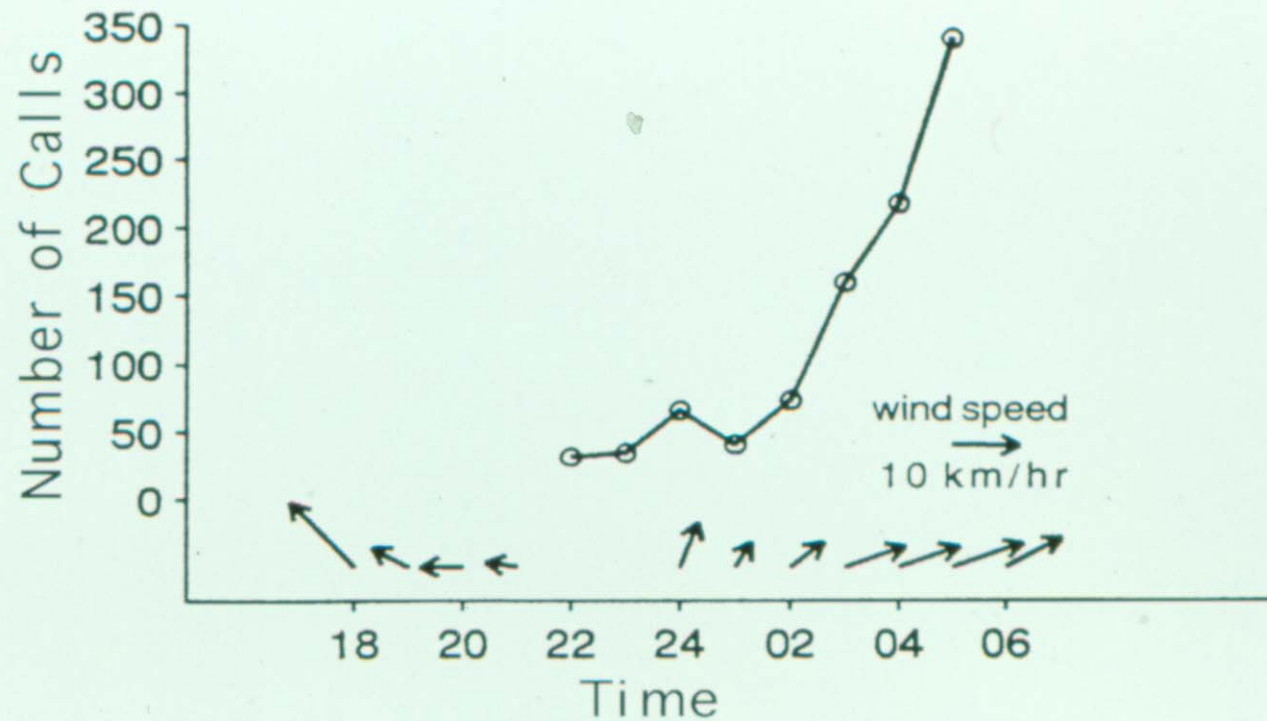
ELEV: 0.5 DEGREES

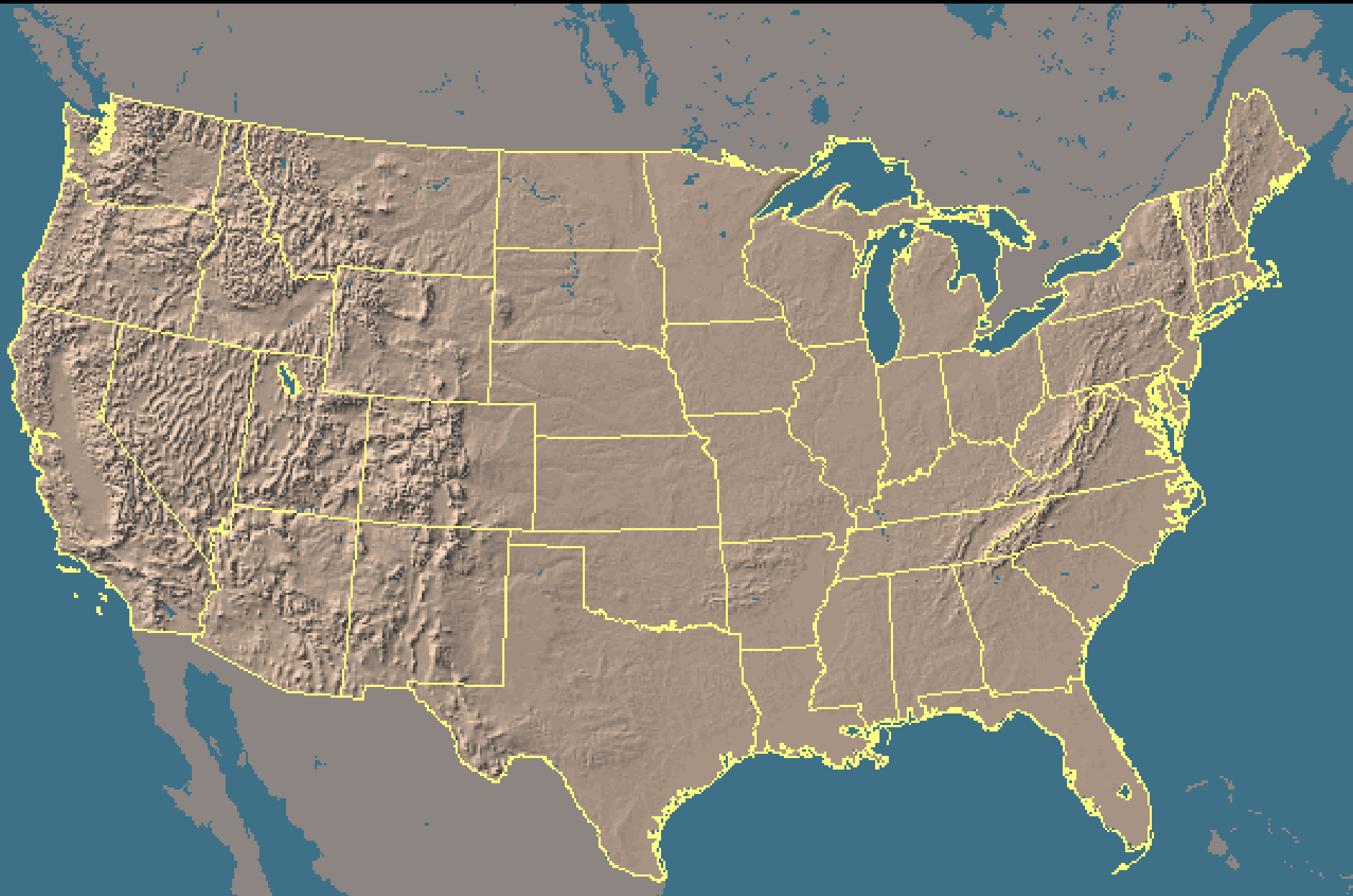
UNITS: DBZ



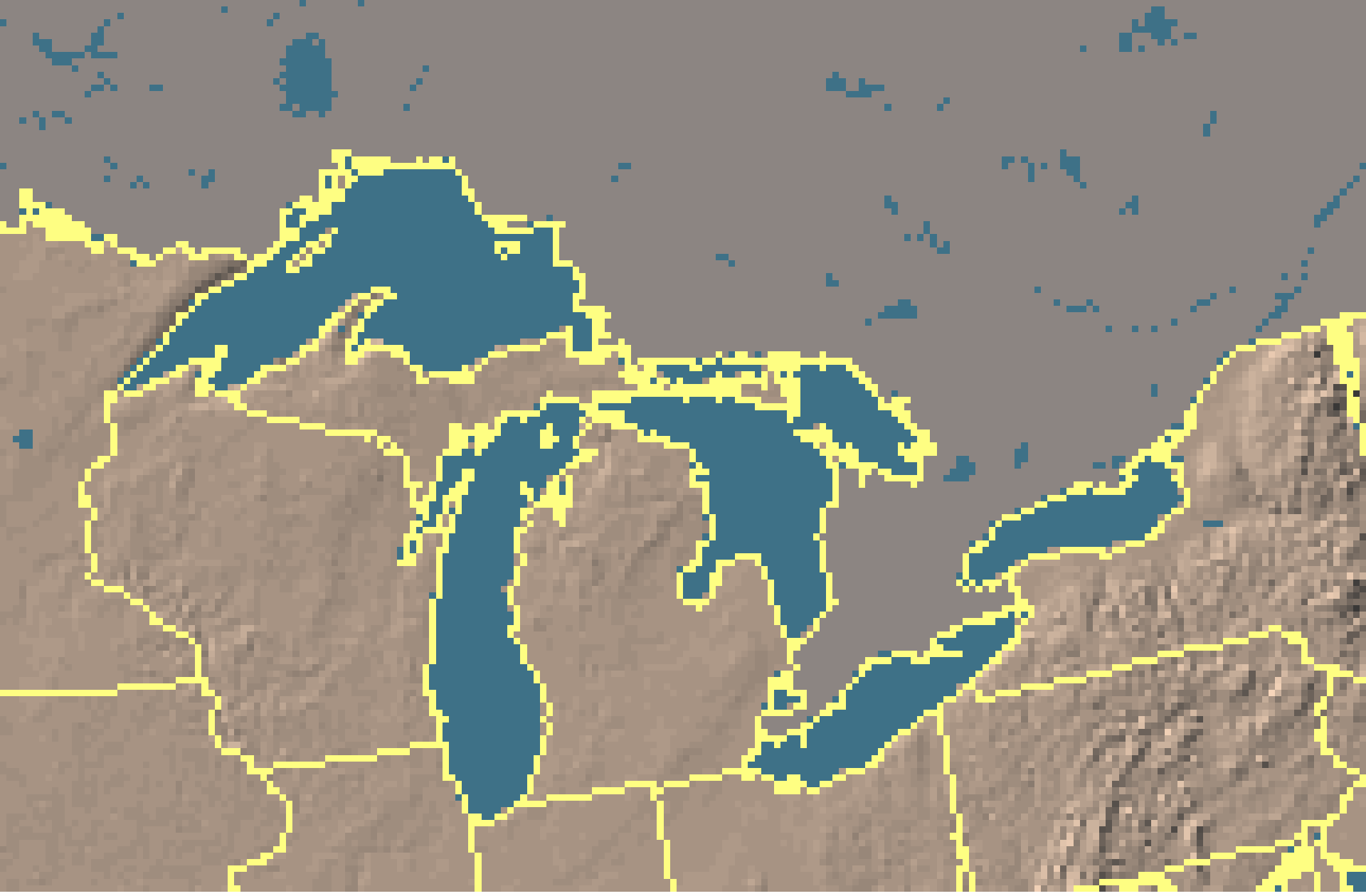
MAX DBZ: 44

Temporal occurrence of sparrow night flight calls and wind direction April 5-6, 1996 LANWR

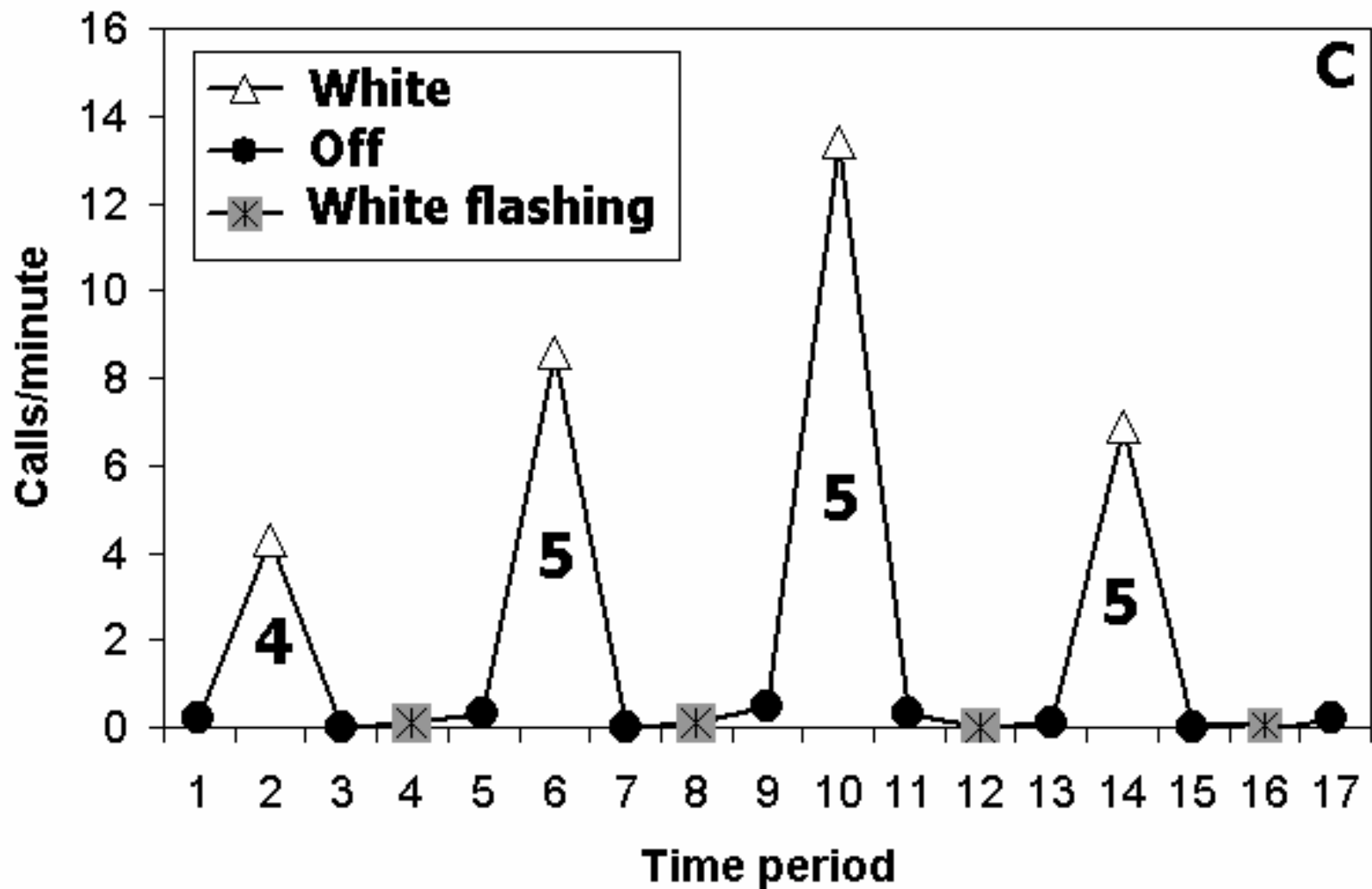




East Coast of Florida has huge low-altitude spring flights when winds are from the SW; light flights when winds are from SE.



Great Lakes have more than a 1000 miles of shoreline. Much of it could have increased density, low-altitude migration in specific weather.



Acoustic monitoring used in evaluating “attractiveness” of different artificial lights to night migrating birds. High calling rates and visual confirmation of birds flying in the lighted space indicate bird aggregation -- in this case in solid white light but not in flashing white light.

NOCTURNAL MIGRATION IN ILLINOIS – DIFFERENT POINTS OF VIEW

RICHARD R. GRABER

“The application of a variety of techniques to the study of migration seems, at times, to confuse rather than clarify the picture. Some of our observations made using different techniques seem even to be contradictory, and yet each method of study probably contributes something to our understanding of the truth.”

Summary of acoustic monitoring strengths for wind/bird evaluation

Preconstruction –

Only method we have for studying species in active nocturnal migration.

Species composition

Measuring absolute migration density is not the goal of acoustic monitoring. It is used as a relative indicator of migration density. Monitoring the density patterns of large numbers of birds as they respond to the landscape, weather, artificial lighting, etc. It appears to be very useful for eliciting flow patterns of bird migration density in some regions of the continent, including the Great Lakes Basin.

Montane channeling dynamics

Coastal concentration dynamics

Aggregation in artificial light (especially offshore)

Cont.....

Postconstruction

Develop index for predicting kills by carrying out acoustic monitoring in conjunction with mortality surveys

Potential indicator for collision, especially with larger birds

Indicator for activating tower searches

Remote monitoring of activity at offshore sites.



Site of Nebraska acoustic study at proposed wind project
Fall 1996 – Spring 1997. Study targeted species composition of
migrants and documented collisions with tower and distress calls.